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CONTENTS

THE NEW PARTNER OF THE EUROPEAN UNION IN THE FIELD OF SECURITY AND DEFENSE

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Abstract: *Existing global threats to the security of modern societies such as terrorism, proliferation of weapons of mass destruction, environmental and climate change, provoking a search for global responses and responses to ensure peace, peace and stability. Against the backdrop of these priorities in the public agenda, the issue of the role of the European security architecture in the international relations system is particularly relevant as the latest security-related EU documents make a clear call for the EU to adopt as a global a security actor.*

Keywords: *"Brexit", security, defence*

1. INTRODUCTION

By analyzing the EU's defense scenarios, it should be noted that the two-speed military homogenization in the EU, with permanently structured cooperation between member states, remains the integration scenario with the highest probability. It is important to note that this scenario is the one that responds closely to the wishes of the old member states, as this arrangement does not require a change of the existing contracts and is feasible within the framework of the Lisbon Treaty toolbox. The scenario that comes close to federal logic for a single European army, according to expert analysis, is likely to happen either after 10 years (28%) or never (27%).

2. EUROPEAN UNION - THE COMMON SECURITY AND DEFENSE POLICY

After the leaving of Britain, the scenario for a single European army was more acceptable in comparison to the time preceding the referendum (before June 23, 2016).The withdrawal of UK may be an opportunity for greater integration, given the United Kingdom's firm opposition to closer integration and the transformation of the EU into a super state .This would mean much greater autonomy in the area of foreign policy, security and defense. However, this opportunity should be the result of sound and timely political decisions, at European level. If European leaders are disposed to think soberly and rationally and are able to bring the interests of the Union to the fore and not their personal ones, the main loser of the so- called "Brexit," would be Britain. The UK debate on leaving the European Union has ignored the potential implications for security, foreign policy and transatlantic relations in Europe.

According to leading military commanders, Britain's exit will limit the UK's ability to overcome international challenges and dangers such as Islamic State of Iraq and Syria (ISIS) or the rise of Russian nationalism. Watching the world today, they see that Britain will be safer and stronger within the Union [1].

The British Security and Defense Strategic Review of 2015 shows that the UK government and security agencies are concerned about the transnational nature of threats to the United Kingdom - the fight against terrorism, extremism, cyber attacks, organized crime, threats to key infrastructure, requiring a coordinated approach with the EU and other partners [2]. With Britain retreating, it is expected that Germany will begin to play a key role in the EU's common foreign and security policy, given its leading position in European diplomacy over Russia.

Concerning the military industry and in the context of the declared European Army, France will have a key role to play in convincing Germany, which after World War II is restricted on the number of army personnel and avoids being perceived as a leading military power, to consider the army only within the NATO structure. If the United Kingdom decides to prioritize its cooperation with the United States and not to continue the joint defense initiatives with France, it will have an impact on the European Defense Technological and Industrial Base (EDTIB) [3].

The two referendums in the Netherlands [4] and the UK are a typical example of how attempts to accumulate electoral support and take part of the voices from the ultra-formations, the pro-European parties, either change their rhetoric with a critical tone towards the EU or become passive when have to talk about it.

This has its current political logic but, in the long run will lead to evisceration of the political actors, to their unification in a direction that is not constructive for the Member States and for Europe as a whole. The weakness of Eurosceptic is in the lack of vision, but the power is in their "anti-speaking". The strength of the European parties is the EU's achievements and the potential for its development, but the weakness of the pro-European parties is in the fear of making the right decisions, and they are very likely to pay a high political price in the future.

In the EU, at best, we have figures that run governments, but there are no leaders to lead the nations [5], and now Europe desperately needs exactly this. What happens on the world stage puts the international relations in a new context and represents a test for the preservation and consistent application of generally accepted international rules and principles. In this respect, the innovative approach to complex and integrated knowledge, value added innovation and / or value added improvements with calculated risk will be of utmost importance to the upcoming discussions on the future scenarios for the European Union. European and national leaders and policymakers should not allow themselves to live in the past. This implies making responsible decisions here, which is the basis for the impending future.

It should be noted that Britain's exit after 44 years of membership in the European Union, the arrival of the new US administration of Donald Trump and his position about the Union and NATO, the EU, and US relations with Russia and Turkey, the migration and refugee crisis, have led to the mobilization of political will and the emergence of:

- New Global Strategy for the Common Foreign and Security Policy of the European Union - Common vision, common actions; stronger Europe;

- Single Security and Defense Package. On November 30, 2016, The EU High Representative for Foreign Affairs and Security Policy - F. Mogerini, announced the framework consisting of the following three key elements - 1 / a plan to implement the European Global Strategy; 2 / Implementation Plan of the NATO-EU Joint Declaration of the Warsaw Meeting in July, and 3 / Action Plan for the European Defense Industry to be strong, smart and innovative and related to the launching of an European Defense Fund , providing € 25 million in the European budget for 2017, providing funds for joint investment projects for research and technology development in the defense sector.

By 2020 this fund is planned to reach € 90 million, and in the debate on the next Multiannual Financial Framework post-2020, the European Commission envisages setting up a 500 million annual defense research program [6]. This will be, on the one hand, a test for the unity of the institutions and the Lisbon Treaty, and on the other hand it will show the key role of the Member States' governments, and their national parliaments in the decision-making process.

- White Paper on the Future of Europe, with a focus on security and defense in the five scenarios for EU development by 2025, highlighting as well the need for significant efforts to consolidate European leaders around preserving Europe's unity and forming a common strategic vision;

- The Rome Declaration [7] signed by the 27 EU leaders on the occasion of the 60th anniversary of the Treaties of Rome, focuses on the need for more secure and stronger Europe. It is related to the creation of an integrated and competitive defense industry; as well as strengthening the Common Security and Defense protocol in cooperative complementation to NATO.

The European Security and Defense Policy was the focal point in the Security Conference report in Munich [8]. Despite the assurance the Europeans received from US Vice President Mike Pens for strong US NATO support and a "steadfast" commitment to their transatlantic allies, European countries were previously invoked by President Trump to dedicate more resources to defense. In this regard, European leaders need to realize the necessity for more independent and firm approach to accentuate the strength of its unity [9].

3. THE GLOBAL STRATEGY FOR FOREIGN POLICY AND SECURITY POLICY OF THE EUROPEAN UNION

Despite the slow process of strategic reconsideration of the security environment, the emergence of new strategic documents in the EU security and foreign policy area is a positive step, as the situation in the Middle East, North Africa and Ukraine demands increasingly and intensely a strategic vision that would take into account both the current dynamics and the new realities along with the security and defense challenges in Europe. The EU Global Strategy for Foreign and Security Policy is an important step in the process of defining the level of ambition of the Union, its strategic objectives and its military capabilities. It shows: [10]

- What type of player the EU wants to be - global. The document proclaims the Union's aspirations for strategic independence, its ambition to exert global authority, not only in terms of its geographic dimension but also of the instruments and policies at its disposal. It notes the EU's willingness and readiness to be engaged in operations and missions outside Europe;

- What type of power the EU wants to use - a combination of soft and firm power. The document recognizes that while the Union is best at using soft power, this is not enough in the context of the new challenges in a world of "foreseeable unpredictability." This highlights the need to strengthen the EU's credibility in the field of security and defense;

- what budget should be earmarked for defense; - there is an attempt to allocate sufficient defense spending, use resources as efficiently as possible, and meet the collective commitment to spend 20% of the defense budget on equipment, research and technologies. The document launches the idea of an EU-wide coordinated process for Member States' military spending plans, which could lead to closer alignment of defense planning and capacity development. This should be done in full uniformity with NATO's defense planning process.

The European Defense Agency (EDA) should play a key role by strengthening the Capability Development Plan acting as a mediator between the Member States and the Commission, assisting the Member States to develop the capabilities arising from the objectives outlined in the Strategy;

- What is the EU's ambition for new technologies and investments in the field of the European defense industry; - the pursuit of creating a solid European defense industry and developing capabilities with the ultimate degree of interoperability and harmonization. It is envisaged that the EU funding in the next budget cycle will be of crucial importance for the development of the defense capabilities that Europe needs.

- How its synergy with NATO to be enhanced: – to deepen the transatlantic link and intensifying the EU's partnership with NATO. The strategy paper reinforces the EU's contribution to Europe's collective security by working closely with its partners, with NATO on the first place.

The EU Global Strategy marks out that: "while NATO exists to defend its members, most of which- European countries, from outside attacks, Europeans need to be better prepared, trained and organized, to be able to contribute decisively to these collective efforts, and act independently if and when it is needed. For Europe to promote peace and to guarantee security on its territory and beyond is of extreme importance to have the necessary ambition and certain level of strategic autonomy[11]. "

In the official conclusion of NATO Communiqué following the Warsaw Summit, the European Union has been highlighted as a unique and key partner of the Alliance, especially in the context of the occurrences at the South and East borders of the two organizations. The independent legal personality of the EU as a result of the Lisbon Treaty, and the NATO-EU meeting in Warsaw, which resulted in the signing of a declaration for cooperation by the Secretary-General of the Alliance - J. Stoltenberg, the President of the European Council - D. Tusk and the President of the European Commission - JK Juncker, has increasingly identified the European Union as a strategic actor on the international scene.

NATO welcomes the emergence of a Global Strategy for the European Union's foreign and security policy, paying particular attention to:

- Strategic cooperation with the Union in response to common challenges with emphasis on cyber-security, migration and hybrid threats;

- A strategic partnership in a spirit of full mutual openness, transparency and complementarity, with the agreement of the two organizations to respect their autonomy in the decision-making process and their institutional integrity [12].

The new strategic context outlines the opportunity for the EU to be considered as an autonomous global strategic player, active in the field of security and defense, acting in close cooperation with NATO and conducting a meaningful Euro-Atlantic dialogue with Russia.

Key steps in this direction are related to:

- the development of the EU's Global Strategy for Common Foreign and Security Policy into a smart strategy that responds to the new realities and challenges in the security environment;

- to prevent, on the side of the European leaders, the UK exit of the European Union to lead to the domino effect and to deepen the problems in the EU, to take advantage of the opportunities for greater integration of the Union in sensitive areas such as security and defense;

- Reflecting on the idea of changing the direction and sequence of the integration stages, namely post-Soviet republics, first to join the EU and then NATO, applying the method of negotiating.

- Improving the interaction between the EU and NATO in the modern security environment. In the context of the EU's position as a global actor and its ability to respond quickly to new geostrategic realities and challenges, a close cooperation with NATO is needed, focusing on a common vision of threats, a higher degree of integration, interoperability and augmentation among the Allies.

4. CONCLUSIONS

The EU should be defined as an intelligent force, which means applying a combination of hard and soft power in effective strategies in different situations, being pro-active rather than merely reactive to the changes in the modern security environment. Only then a common vision and action for a stronger Europe can be taken. Thus, the EU's Global Strategy, besides epitomizing the transformation and / or adaptation of the EU in response to the changes in the security environment, together with the accompanying documentation will be the basis for modeling the environment through strategic vision and prevention from future risks and threats.

Whether this will happen, the future will show. Due to the great dynamics in the security environment and the forthcoming debate on the future of Europe and related to a series of expected documents, which will definitely give food for thought including the European defense perspective and the proposal for a European Defense Fund, the question remains to be answered.

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THE PROFILE AND MODALITY OF RECOGNITION OF RELIGIOUS FANATICS AND THREATS TO THE ADDRESS OF THE SECURITY OF THE POPULATION, DUE TO THEIR NON-IDENTIFICATION

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Abstract: *Religious fanatics have created risks to individual and collective security, amid intrinsic manifestations in the relationship with community members. The behavioral profile of fanatics is a rejection of society in general, of not integrating and reporting to its own system of thinking of all people. The problem arises when people do not realize that they are at risk when they become indolent in accepting a fanatical profile and how they can be recognized. When the landmarks transmitted by fanatics, whether violent or non-violent, become habitual and no longer considered to be peculiar, risks are generated by misappropriating objectives of capital interest to society.*

The more a person can identify a religious fanatic, he can also take the necessary measures to counteract the effects of such individuals. This category includes simple people, but manipulated to reach non-religious goals, but which greatly affect the community they are part of. In order to establish a pattern that can be considered a guideline for the recognition of religious fanatics without being considered exhaustive, I will treat in this material the profile and the way of recognizing religious fanatics as well as the security risks generated by the lack of knowledge of such a pattern.

Keywords: *religious fanaticism, profile, mechanism, threats, peculiarities, non-violent, recognition*

1. INTRODUCTION

Religious fanatics have atypical behaviors, sometimes violent but often non-violent, but with far more complex repercussions because it generates risks to community security by adopting decisions that they do not realize in willingly.

Risks are generated as a result of the fact that those followers either do not attract special attention unless it is too late or have some patterns that go beyond normal social conduct. In this sense, Sigmund Freud states that there are people whose affections change frequently, especially to extremes, either depressive states or overflowing happiness, ie these states are amplified for simple and unreasonable reasons, or in stressful situations they act without energy [1].

That's why recognition of these religious fanatics is important. An element by which a religious fanatic is recognized is also the degree of involvement in religious activities, in the sense that such a person is active in the religious community of which he is part in paralleling interaction with other persons who do not share the same religion, finds it at a low, very often non-existent level.

The fanatic type keeps active rituals and the confession of faith, two important elements in its relationship with divinity, and the attempts to change such manifestations underlying religious fanaticism are unsuccessful, and in this equation the cleric is very important because controls such a phenomenon, constituting a safety valve for strong religious feelings [2].

Fanatics have a behavior specific to their religion or sect, both as an external manifestation of their own personalities developed under religious influences and in their relationship with those with whom they interact, but most importantly, they adopt a confidential code of their own confession concerned. It is not an element of religious fanaticism that the members of a religious community go to the sacred place or the worship place to pray. But it is a landmark when a person leaves, regardless of the consequences, the workplace to appear at the prayer site or in particular to pray to the deity he believes in at the pre-established moments. An example is that of some Islamic religious followers who pray five times a day as required by the precepts, a request that can not be respected by most Muslims, due to daily activities, which is again permitted by doctrine. For example, fanatical followers of the al-Qaeda terrorist organization can be recognized for Islamic culture and tradition, and men have besides clothes and long beards [3].

Any member of a religion, whether it is the one born in that faith, or whether it is the free adherence of the adept to a cult, always subjectively perceives the religious experience, because in itself this expression in some cases means the refusal of one commitment or loyalty to the religion itself, which involves an inner transformation.

The practice of a religion means the fundamental change of the adept to the divinity and, in the name of this divinity, first to avoid harming the other members of its religious collectivity, and to in no way affect the followers of other religions in the name of the Supreme Being believe.

2. PROFILE OF FANATICS PERSONS

The profile of the fanatic is a well-defined one, in the sense that it presents and transmits certain signals and messages, including the fact that they do not stand out, have no vices, and make great efforts to disturb the people they interact with. Due to the fact that religious fanaticism is supported by feelings at the expense of human reasoning, people who have this religious feeling stand by the fact that they are inconsistent with the evolution of the society in which they live, in the sense that all people think of professional advancement and implicitly a remuneration superior to access to a higher education and health system, to the quality of the neighborhood in which it lives, that is to say, how badly it is, but the fanatics do not emphasize these benefits [4].

A person who exacerbates religious zeal becomes intolerant to those of another faith, which is why he deliberately conveys signs of contempt and does not want to interact with them, as well as the fact that he has to dominate, that is to say, others to be afraid and, walks on the other sidewalk of the street, fanatics feeling the need to acquire a sense of power by being circumnavigated and others ceding.

Emil Cioran said that the fanatic raises the voice in the name of the divinity, does not conceive that the people he interacts with has another system of moral-spiritual values than he wants to make known, and his emotional downloads resulting from faith want impose on others with whom they come into contact [5].

The description of fanatics has some features that can be seen in such people, but with all these, no clear conclusions can be drawn about their personality. However, based on these, one can develop a profile of religious followers who have a higher or lower level of inclination towards fanaticism. The features of a religious fanatic are sometimes obvious, but they are not once, this being influenced by the level of understanding of the religious doctrine of one's own confession, without influencing the degree of fanaticism, in the sense that this phenomenon can be reduced to the basic idea that has to do a certain thing, but the understanding of the religious doctrine is infinite, because the religious zeal goes beyond the limits of normal human behavior.

In this respect, Michael L. Klassen affirms that religious cults and religious sects, including religious entities that are organized independently, as well as their followers, are subjectively looking at religious leaders, exacerbating their qualities, looking at them as "certain people of God" [6]. Instead, they manipulate the provisions of the holy books of their own confession to justify their actions, because they are always regarded as infallible by adopting erroneous conduct with regard to the signs of divinity as well as the frequent use of the products of the technological revolution to trigger , radicalizing and monitoring the activity of fanaticism of followers [6].

As a result, the profile of a fanatical person is the following: Because of the extremely high degree of indoctrination, such persons can no longer regard religious leaders as they are in reality, with positive and negative parts, exalting only their qualities, criticizing them never and will not accept to criticize others; religious leaders interpret the teachings contained in their own holy books in a subjective way, considering them to be transmitted by God, Allah etc., and must be adhered to ad literate, although they must also be interpreted in their spirit, and by their actions may be severely affected those who are identified as their opponents, thus revealing the pattern of fanatical people by not accepting other religious views; also people who guide their lives on the basis of religious precepts, along with some divine signs that have been shown to them or their leaders, and who are waiting for other divine interventions, reveal the fanaticism of some people; the sustained reporting of the followers to the benefits of society only when they support their doctrines, otherwise they are considered to be detrimental to their religiosity, for example, social networks are considered to be satanic, but when used to achieve their own goal they are accepted because he considers that there can be an exception, and deity will accept it, thus revealing the hypocrisy of their conduct.

Amos Oz says that a religious fanatic can also be recognized because he does not have the sense of humor, the result of observing this in the state of Israel where he was born, grew up and lived in 1939.

It is important to note that this conclusion is objectively obtained from an area that has been and is the theater of terrorist operations on the one hand and counterterrorism on the other.

3. THE MODALITY OF RECOGNITION OF A FANATICS

A fanatical person manifests himself in a certain pattern, that is, as he behaves, both in private and in public, both individually and in the crowd, both alone and in interacting with others. This pattern refers not only to behavior but also to the manner of reporting such a person to his / her life or to others, or the exteriorization of religiosity and the appropriation of the doctrine of the confession in which it belongs.

3.1 - Fanatics can be recognized as belonging to and strictly adhering to particular eschatological doctrines, that is, the precepts of what happens after this life, that is, the obtaining of the later life.

This is more important than the debts of this life, such as ensuring a decent living for the family, especially for its children or for society, where it grew up, educated and provided a space for it to grow personally and professional. Eliseo Vivas said that some fanatics are adventists of Adventist cult because they believe that the advent or second coming of Jesus Christ to earth will be preceded by a catastrophe, and after that all prophecies will be fulfilled, events that will have place only because of the divine will [8].

Such fanatical individuals refuse to obey social mechanisms that draw rights and obligations for each individual, one of which is that other members of society, regardless of their religion, must be respected. This is not respected by religious fanatics, considering that people who do not share the same faith with them are sinners, which is why they are not at the same higher socio-religious level, an attitude from which their religious intolerance resides.

3.2 - Another way of recognizing religious fanatics is that of ideas about the community in which they live together and their imposition in the sense that for such persons, that society can not and does not exist without the religious precepts, or it functions at functional parameters only because of religion represented by them. Or it is totally false, because human communities existed, exist, and will exist without a particular religion, even though it was present in all kinds of human organizations, regardless of the degree of religiosity that manifests at its level. This reveals that it is only in the minds of fanatics that society as a whole must be molded according to their religious precepts, which they do not hide, but on the contrary they consider it their duty to extort them and claim that the audience and respect it.

Regarding the reporting of religious followers to social norms, religious fanatics are morally unreasonable without respecting the right of others to religious freedom, and the nominees are respected only if they do not contradict the precepts of their own religious belief [9] . This statement is also reinforced by Maxwell Taylor who says that two processes related to the human psyche, namely prejudice and authoritarianism, have a series of cognitive processes in common with fanaticism, namely: the inflexibility of religious belief, the refusal to compromise in confessional divergences, the lack of consideration of the alternatives, accepting only the things painted in black and white, the look of society through a refractory mentality to complex things. [10] Leonidas Donskis also states that "a fanatical belief in a set of values and ideas is supported by a positive refusal to admit the existence of other sets of values and ideas" [11].

Some of the landmarks that can be used to identify religious fanatics are the appropriation and development of feelings of intolerance towards those who do not assimilate their own visions, whether they are other confessions or have the same religious cult. Carl Goldberg says in this sense that the leaders of true religions do not spread into intolerant doctrines, especially to hate and persecute those who oppose them, as the leaders of fanatical cults and sects do, on the contrary, share ideas of helping others, even if they are not of the same confession, for the development of a harmonious society [12].

3.3 - Fanatics can also be acknowledged by their permanent reference to the symbolism of their religious cult or other religious symbols, in the case of newly established groups that they adopt. With the exacerbation of religious zeal and the development of intolerance towards opponents of another faith, symbolic exacerbation is also exacerbated and the religious symbols are automatically overstated, which they portray without taking into account the fact that their actions could offend the rest of the members of society who do not share this type of religiosity.

Thus, some Muslim religious people who dress according to the Qur'anic precepts in secularized communities are not representative, but they did not think that the action would generate reactions from the rest of the population. Religious fanaticism indicates the necessity of completing sinful life and obtaining intrinsic non-marriages [13]. On the other hand, all fanatics become aggressive and intolerant of those who do not accept these symbols, being extremely offended that others do not obey their own religious values.

3.4 - Religious rituals and ceremonies are another element after which fanatics can be recognized because they follow ad-literam and do not adopt the principle of respecting only the spirit of religious norms. These elements of exteriorization of religious feelings are very important not only as a form of manifestation, but also because in those moments, the followers participating in such events begin to exponentially increase their enthusiasm and implicitly the fanaticism, which has often degenerated into violent conflicts with both those who interacted with them and the authorities that tried to settle the situation.

3.5 - Cruelty is a defining element for a fanatic. There has not been, there is no, and there will be no religious fanatics demonstrating mercy. Such persons believe that they are the bearers of the supreme truth, which is why they become arrogant and behave according to their beliefs, which makes them erroneous in most of their actions, and contrary to their own religious precepts that formally have their cults.

Eliseo Vivas affirmed that the fanatic is recognized after a certain signal, namely the cruelty, the behavior generated by the arrogance that takes possession of such a religious follower, and what is most dangerous to the rest of the members of society is that he also boasts the fact that it is not merciful, justifying this by the moral foundations of one's own confession. [8]

3.6 Fanatic adherents can also be recognized by the religious philosophy they have adopted about their own doctrinal confession and ideology, in the sense that their faith is the only true and outside of it there is no other reality to transpose the divine-human relationship , and which they confess without any social, cultural or religious restrictions to the people they interact with. From this religious conception lies also the influence on their degree of fanaticism in the sense that it generates the increase of religious zeal and implicitly the intolerance towards those of other faith.

In this sense, Danny Scoccia says that a religious fanatic is the person who claims that his own confession is the only true one, and only those who accept it can be saved, although by the latter statement the religious fanatic becomes or is already intolerant of confessional, because it excludes others from having the same natural rights as they were born [9]. A fanatical religious adept always wants to impose his own religion, not because he believes in it, but because he thinks he is the real one, the mob of his inner force that maintains fanaticism.

This is complemented by the psycho-sociological need existing in some individuals who need the spirit to be satisfied with feelings of belonging to a confession and loyalty to a divinity. In addition, it must be stated that all people must realize that there are individuals who have the naked soul, that is, they do not connect to any landmark of modern society, for which such people feel a strong attraction to a religious belief, which is based a definite dogma appropriated by followers as the divine supreme truth to which unbelievers must be subjected as a mandatory and defining condition, otherwise they should be condemned and killed. [12]

3.7 - Fanatic adherents have an absolute fidelity to their confession, preached and learned teachings, but also to their leaders, not allowing human reason to penetrate adopted decisions, beliefs, consciousness and the actions to be followed.

The discourse of such people is one-sided one, usually containing some basic or guiding ideas, accompanied by an intransigence to opposing opinions, even though they have strong arguments in combating certain manifestations of the execution of religious zeal and intolerance by those of other faith.

Laurie Calhoun affirms that fanatics believe that they have revealed the full knowledge of the surrounding world, and implicitly the relationship with divinity, which is why their violent actions are justified, and because of their failure to cover other people to their own religious beliefs by methods peaceful use of violent actions to achieve their goals by dehumanizing the victims by such followers who like the new found sentiment, namely to "play the role of God." [14]

Generally, a fanatic has as a fundamental mark that guides his reason, actions or claims, an authority or only a sacred book. The inner energy that moves and maintains fanaticism is a strong desire to impose upon others their own doctrines and religious visions, showing a predisposition to its exclusion from the community or community towards its group, the existence or development of a sense of illogical hatred towards different categories social development of people, the development of a strong loyalty to some ideas or leaders that are not of major importance for their beliefs [8].

Thus, religious people develop certain religious purposes because they have the mental characteristics of a perfectly obedient militant. They strongly believe in the goals set by leaders because of the degree of religious indoctrination and anyone can actively participate in their fulfillment, but only the fanatics are part of the core of the secret activities, the rest being part of the members that ensure the logistics and support of the normal functioning of the organization.

4. THREATS TO THE NATIONAL SECURITY ADDRESS

Religious fanaticism is manifest in those who are prepared to receive an extreme doctrine, because for the great majority of members of religious communities this type of theology is not of interest and is often very much disavowed, as is the case in all major religions, whether it is Christianity, Islam, Buddhism, Shintoism or Mosaicism. Modern benefits are used to model the profile of religious fanatics.

People who show high religiosity and overlap with certain personal or professional discontents, depending on society as a whole, give birth to a category of people who are easily racid by representatives of religious sects or cults because that is what they are looking for personal troubles in a profound way, or those who no longer have an anchor of emotional stability and balance in a family environment, or on the basis of religious indoctrination, have a high degree of frustration and have developed strong antisocial feelings against its co-nationals and fellow citizens [13].

Such persons are sought after by the representatives of the religious entities who want to turn them into loyal followers of their causes and who in turn directly support the achievement of the objectives set by the organization, including by the supreme sacrifice, and in the last years have benefited in this respect and the support of modern technology in the area of information technology, ie social networks such as Facebook, Instagram, LinkedIn, Hi5, Google+, Twitter, Youtube, etc.

These virtual environments are prone to recruiting new members to support the actions of religious sects and cults because under any circumstances they attack the lives and physical integrity of a broad category of people not involved in religious activities but with social and political objectives, seriously affecting national security of each state [13].

The profile and mode of action of religious fanatics is heavily influenced by virtual space, but also vice versa, that is, religious fanatics manipulate scaled networks to disseminate doctrine and fanciful precepts and which are mastered by many people.

CONCLUSIONS

The most loyal members of religious entities are those who reach a certain inner peace of mind after adhering to cult, considering themselves as spiritual reborn themselves, and as a result of it they feel that they live again, sparking new feelings that, they make them believe that they can do any deeds in the name of the divinity, because they are both accepted and forgiven, even crimes.

That is why religious fanatics transmit signals through their behavior on the one hand, and on the other hand, the rest of the members of society have an obligation for them and their loved ones to pay attention to these signals and to take protective measures. It is important either because we are talking about terrorists, whether they are people who refuse authority because their religious fanaticism is being manipulated, and they want allied troops in our country, and religious leaders are at the head of protesters.

When they are preached by a religious doctrine that exacerbates their religious zeal, they are inoculated with the idea that it is only then that they are happy and the process of inner transformation has begun, and the previously accepted social conduct rules seem to be out of the question.

Everyone who felt that they had been marginalized by society and humiliated by it, they found relief in religious movements that did not preach religious tolerance, but on the contrary, refusal, and hence the way of recognizing religious fanatics and preventing security risks.

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CHANGING THE LEVEL OF SECURITY AND IMPACT ON ECONOMIC COOPERATION IN THE CONTEXT OF THE THEORY OF REGIONAL SECURITY COMPLEXES

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Abstract: *The South China Sea is an area of extraordinary geopolitical significance. The region is characterized by territorial disputes between ASEAN and the PRC. The dispute intensified after military drills were launched in the South China Sea to demonstrate the military strength of the region's states. South Asian land claims are made by seven Asian countries: Brunei, People's Republic of China, Philippines, Indonesia, Malaysia, Taiwan and Vietnam. The article focuses on the situation between China and selected states of the Association of Southeast Asian Nations - Brunei, Philippines, Malaysia and Vietnam. In recent years, the geopolitical balance of the region has changed in the wake of China's military growth and, in parallel; the agitation of neighboring states has increased. The aim of the article is to investigate the impact of changing the level of security on the development of economic cooperation in the ongoing territorial disputes in the South China Sea. The author analyzed the development of the political-security situation between the People's Republic of China and selected states, focusing on the development of international trade between countries in the context of changing the level of security.*

Keywords: *trade balance, regional security hegemon, economic cooperation, regional territorial disputes*

1. INTRODUCTION

Security defined by the realist is, the state of absence of military threats to the state's survival in the anarchist system of the international system. (Sulović 2010) Carnesale and Nacht (1976: 2) defined security as a set of factors with "a direct impact on the structure of the nation state and the sovereignty of its members, with particular emphasis on the use, threat and control of military components". Wolfers (1962: 149) states that state security "in an objective sense measures the absence of threats to acquired values, and in a subjective sense the absence of fear of attacking these values."

Copenhagen School, characterized security as (Buzan, 1991: 37) "the ability of states and societies to maintain an independent identity and functional integrity." Buzan, Waever and de Wilde (1998: 27) defined security as "survival despite existential threats." The original military concept of realists was expanded to include four areas of potential threats, such as the political, economic, social and environmental sectors (Buzan, Waever and de Wilde 1998).

The security constellation is closely related to the theory of the regional security complexes of the Copenhagen school. Buzan and Waever (2003: 491) characterize the security constellation as "a general formula formed by the interplay of four levels: domestic, regional, interregional, and global." The Theory of Buzan and Waever (1998) describes four levels of relations in the regions where the security constellation is

concerned. These include the vulnerability of the individual states in the region, the relations between the states in the region, the interaction of the region with the neighboring regions and the role of the global superpowers in the region.

The theory of regional security complexes fulfills three important functions that indicate the appropriate level of analysis in security studies and allow the development of security scenarios for different forms of regional security complexes (Buzan and Waever, 2003).

The basic element is the concept of neighboring geographically close states. Geographic location affects the intensity of interaction between individual actors because they are located in one region and can pose a security threat to a particular state.

War conflicts consume financial resources that could be used to promote food production. They disturb the distribution of food supplies and lead to interruption agricultural production. (Korecki, Staňková, Cabicarová, 2015)

The standard principles forming the regional security complex are the division of power, rivalry and alliance among the major powers within the regional security complex. The emergence of co-operation and hostility at regional level is influenced by historical and political elements and material conditions. If the rivalry between some states is very strong, the principle of penetration is added to the formation of the regional security complex. (Buzan and Waever, 2003)

The emergence of the regional security complex must "have a sufficient degree of interdependence so that it can be considered a linked group and could be distinguished from the surrounding security regions, Buzana and Waever (2003: 47-48)

The last variable is the exclusivity or overlap of regional security complexes. The author has worked with the fact that the ASEAN states have an exclusive regional security complex.

For achieving effective use of military and commerce capabilities in the logistics support process of the units located in the foreign countries there were restructured aims and were equipped by performance metrics and quantification (post research activity). (Pomazalová, Korecki, Darkwah, 2010)

The basic structure of the regional security complex consists of four elements (Buzan and Waever, 2003), which are boundaries, anarchic structure, polarity, and social construction.

2. ANALYSIS OF THE SECURITY SITUATION AND THE DEVELOPMENT OF ECONOMIC COOPERATION

Association of the Southeast Asian Nation (ASEAN) was founded on August 8, 1967. The founding states were Indonesia, Malaysia, Philippines, Singapore, and Thailand. The number of Member States increased between 1984 and 1999 on Brunei, Vietnam, Laos, Myanmar and Cambodia. (Overview 2012)

The performance of the economy is characterized as the total value of the products created by the national economy over a certain period of time. The most important areas are the quantity and quality of human resources, the existence of minerals and other natural resources, the level of technological progress, social and political settings (5 Factors 2015).

The important element affecting the level of security in the South China Sea is the exclusive economic zone legally anchored in the United Nations Convention on the Law of the Sea (UNCLOS).

The exclusive economic zone is an "area beyond the territorial sea and adjacent to it". The EEZ shall not exceed 200 nautical miles (24 nautical miles) from the baselines. The author analyzed the gross domestic product in 2011-2016
In 2011, ASEAN's total GDP amounted to USD 2,081,632 million. The volume of exports amounted to USD 1 239 465 million and the volume of imports amounted to USD 1 154 256 million. Member States achieved a positive trade balance with a surplus of USD 85,209 million. The trade balance indicator on GDP reached 4.09%. Economic performance indicators of ASEAN and China are shown in Table 1.

Table 1: GDP and trade balance of selected ASEAN and China countries in 2011 in million USD (Source: World Bank and WTO, own processing)

Year	**2011**				
Country	**GDP**	**Export**	**Import**	**Saldo**	**Trade volume in % GDP**
Brunei	14 220	12 464	3 628	8836	62.14%
Malaysia	268 516	228 086	187 473	40613	15.12%
Philippines	206 895	48 305	63 692	-15387	-7.44%
Vietnam	123 166	96 905	106 749	-9844	-7.99%
China	6 682 402	1 898 381	1 743 484	154897	2.32%

The volume of international trade between ASEAN and China reached US $ 280,150 million and increased by 21%. Export growth was 13% to USD 127,598 million. Import grew by 28.3% to $ 152,552 million. Total imports significantly exceeded total exports and trade balance with China amounted to a deficit of USD -24,953 million. China's share of ASEAN's foreign trade fell to 10.3% in exports, but rose by less than one percent to 13.3%.

There was an armed conflict between China and the Philippines. International trade between countries grew by 18% from USD 10,678 million in 2010 to USD 12,606 million in 2011. Exports revenue amounted to USD 6,102 million, while expenditure on imported commodities increased to 6,504 million USD, the balance for the Philippines was negative with a deficit of USD 402 million. China was an important trading partner; the share of the total foreign trade volume of the Philippines increased by half a second percentage to 12.7% for export and 10.2% for imports. Changing security as a result of the Chinese-Filipino confrontation did not adversely affect economic cooperation between states.

Chinese activities in the Vietnamese EEZ have escalated tensions. Foreign trade between Vietnam and China amounted to US $ 36,479 million. It increased by 31%. At the same time, there is a rapid increase in business operations with China. Export increased by 50% from USD 7,742 million to USD 11,613 million and imports increased by 23% from USD 20,203 million to USD 24,866 million. The trade balance was deficient by USD 13 253 million. China was an important trading partner with a share of 23% in the import and a 12% share of the export. Changes in the level of security did not have a negative impact on the intensity of international trade between Vietnam and China.

2012, ASEAN Member States generated total GDP of US $ 2,205,065 million. Exports amounted to US $ 1,253,678 million and imports to US $ 1,223,227 million. ASEAN countries reached a trade surplus of USD 30,451 million. The share of trade balance to GDP was 1.38%. State economy performance indicators are shown in Table 2.

Table 2. GDP and trade balance of selected ASEAN countries and China in 2012 in USD million (Source: World Bank and WTO, own processing)

YEAR	**2012**				
Country	**GDP**	**Export**	**Import**	**Saldo**	**Trade volume in % GDP**
Brunei	14 350	13 000	3 572	9428	65.70%
Malaysia	283 216	227 537	196 392	31145	11.00%
Philippines	220 723	52 099	65 349	-13250	-6.00%
Vietnam	129 629	114 529	113 780	749	0.58%
China	7 207 389	2 048 714	1 818 405	230309	3.20%

ASEAN's international trade volume with China exceeded three hundred billion and reached US $ 319,485 million. Export earnings amounted to US $ 141,892 million, representing an increase of 11.2%. Expenditure on imports of products amounted to US $ 177,593 million, representing an increase of 16.4% compared to 2011. China's share in total foreign trade increased by the share of China in the total volume to 11.3% in export and 14.5% in the import. AESAN reached a trade deficit with a deficit of USD 35,701 million in trade with China.

As a result of Chinese activities, tensions between Vietnam and China have escalated. Foreign trade between countries reached a total volume of USD 41,869 million, an increase of 15%. Exports increased by 11% from US $ 11,613 million to $ 12,835 million, Import increased by 17% from US $ 24,866 million to US $ 29,034 million. The balance of trade balance was negative with a deficit of USD 16,189 million. China remained the most important trading partner for Vietnam, with a share of total imports of 25.5%, representing an increase of 2%. Changes in security due to the Sino-Vietnam confrontation did not have a negative effect on economic cooperation between countries.

There was an incident between the Philippines and China at Scarborough Shoal. The volume of international trade between countries amounted to US $ 13,295 million, an increase of 5%. Philippine trade with China rose 1% to $ 6.159 million in exports.Imports increased by 10% from $ 6,504 million to $ 7,136 million. The negative balance of trade reached the level of USD 977 million. China's overall share of foreign trade in the Philippines decreased by almost 1% in exports but increased by 0.7% in imports, China was a major trading partner with an export share of 11.85% and a share of imports of 10.9% %.

The change in security did not adversely affect the economic relations between China and the Philippines. China has invested almost $ 5 billion this year to support the Philippine agricultural sector.

ASEAN sovereign transactions reached a level of GDP of US $ 2,317,393 million in 2013. Exports amounted to US $ 1,269,971 million and imports US $ 1,243,109 million. The balance of trade showed a surplus of USD 26,862 million. The share of trade balance in GDP increased to 1.16%. Country performance indicators are presented in Table 3.

The total volume of foreign trade between ASEAN and China amounted to USD 350,509 million, representing an increase of 10%. Exports amounted to USD 152 546 million and imports of USD 194 963 million. ASEAN countries reported a negative trade balance with a deficit of USD 45,417 million. The year-on-year increase in commodity exports to China was recorded at 7.5%, while imports from China increased by 11.5%. China was the largest and most important trading partner for ASEAN in 2013, with exports accounting for 12% and 16% for imports.

Table 3. GDP and trade balance of ASEAN and China in 2013 USD million
(Source: World Bank and WTO, own processing)

Year	**2013**				
Country	**GDP**	**Export**	**Import**	**Saldo**	**Trade volume in % GDP**
Brunei	14 045	11 447	3 612	7835	55.78%
Malaysia	296 507	228 330	205 897	22433	7.57%
Philippines	236 315	56 698	65 705	-9007	-3.81%
Vietnam	136 657	132 032	132 032	0	0.00%
China	7 766 512	2 209 005	1 949 990	259015	3.34%

The Philippines unilaterally handed over the Philippine-Chinese disputes over the territory to the International Court of Justice in The Hague. International trade between the Philippines and China grew by 17% from US $ 13,295 million in 2012 to $ 15,621 million in 2013. Exports increased by 14% to $ 7,025 million. Import reached the level of USD 8,596 million. This was a 20% increase. The overall balance for the Philippines was negative with a deficit of USD 1,571 million. China reported an increase in the total foreign trade of the Philippines by 0.5% to 12.4%. Changing security did not adversely affect economic cooperation between states.

Malaysia did not fear changing the level of security despite the Chinese exercise on the Malaysian coast and suggested closer bilateral co-operation. Trade transactions between Malaysia and China reached USD 64,503 million, an increase of 10%. Export increased by 7% from USD 28,742 million to USD 30,775 million. Import increased by 13% from USD 29,723 million to USD 33,728 million. The foreign trade balance with China was negative with a balance of $ 2,953 million. China was the most important import partner for Malaysia in foreign trade with a share of 16.4% of total imports and the second most important export partner with 13.5% of total exports.

Mutual economic co-operation, despite some tension, had an evolving tendency. In 2014, ASEAN's total GDP amounted to US $ 2 422 294 million. Exports amounted to US $ 1,290,830 million and imports amounted to US $ 1,232,556 million. The economic surplus represented a trade surplus of USD 58,274 million. The trade balance accounts for 2.41% of GDP. Country performance indicators are presented in Table 4.

Table 4: GDP and trade balance of selected ASEAN countries and China in 2014 in USD million
(Source: World Bank and WTO, own processing)

Year	**2014**				
Country	**GDP**	**Export**	**Import**	**Saldo**	**Trade volume in % GDP**
Brunei	13 715	10 508	3 598	6910	50.38%
Malaysia	314 333	233 927	208 850	25077	7.98%
Philippines	250 838	62 100	67 718	-5618	-2.24%
Vietnam	144 834	150 217	147 849	2368	1.63%
China	8 333 286	2 342 293	1 959 233	383060	4.60%

The volume of international trade between ASEAN and China increased to $ 366,526 million, an increase of 5% over 2013. Exports fell 1.4% yoy to $ 150,407 million. Import increased by 9.2% to $ 216,119 million. Imports significantly outpaced exports and the trade balance with China generated a deficit of USD 65,713 million.

China was the primary trading partner for ASEAN in foreign trade. Exports reached 11.6% of total export and import levels of 17.5%.

The issue of fisheries resulted in a confrontation between the Philippines and China. China claimed rights in the Philippine EEZ. Foreign trade between the Philippines and China reached a total volume of US $ 18,316 million, up 17% over the previous year. Business transactions have risen. Export increased by 14% from USD 7,025 million to USD 8,033 million, with imports increasing by 20% from USD 8,596 million to USD 10,283 million. The balance of trade balance was negative with a deficit of USD 2 250 million. China's share of Filipino international trade increased by about 0.6% (to 13% of total exports) and by more than 2% (to 15.2% of total import volume). The Chinese-Philippine confrontation did not have a negative impact on economic relations between countries.

As a result of Chinese drilling activities in the South China Sea, Vietnamese nationalism and attacks against Chinese people have grown. Business transactions between Vietnam and China amounted to US $ 58,575 million, an increase of 17% over the previous year. Exports increased from USD 13,177 million to USD 14,928 million (13% increase) and imports increased from USD 36,886 million to USD 43,647 million (an increase of 18%). The foreign trade balance with China was negative with a deficit of USD 28,719 million. China was a very important trading partner for Vietnam and was the most important import market with a share of 29.5% of total import volumes. China was the second most important export market, accounting for 10% of the total volume. International trade has developed positively, and the escalation of tensions and consequent lowering of the level of security have not had a negative impact on economic cooperation.

In 2015, ASEAN's total GDP was US $ 2,531,942 million. Exports amounted to USD 1,155,538 million and imports amounted to USD 1,092,322 million. The trade surplus amounted to US $ 68,216 million. The share of trade balance to GDP is 2.69%. Country performance indicators are presented in Table 5.

Table 5: GDP and trade balance of selected ASEAN countries and China in 2015 in USD million (Source: World Bank and WTO, own processing)

Year	**2015**				
Country	**GDP**	**Export**	**Import**	**Saldo**	**Trade volume in % GDP**
Brunei	13 637	6 352	3 229	3123	22.90%
Malaysia	329 952	199 158	176 011	23147	7.02%
Philippines	266 055	58 827	70 153	-11326	-4.26%
Vietnam	154 508	162 106	166 103	-3997	-2.59%
China	8 908 300	2 273 468	1 679 566	593902	6.67%

International trade between ASEAN and China reached US $ 345,763 million. Export amounted to US $ 134,249 million, imports amounted to $ 211,514 million. The Balance of Payments amounted to USD 77,265 million. International trade volume decreased by 6%, export volume by 11% and import volume by 2%. China has maintained its position as its main trading partner with a total of 15.2% of total trade.

Joint military exercises of the US and the Philippines have posed a threat to China. The volume of international trade between the Philippines and China amounted to US $ 17,870 million. There was a 2% decrease from the previous year to $ 18,316 million.

Philippines and China have undergone radical changes: export declined by 20%, from $ 8,033 million to $ 6,393 million, while China's share of total exports fell by nearly 3%. Import increased by 12% from USD 10 283 million to USD 11 477 million, representing an increase of 1% of China's share of total import volumes. The trade balance was negative with a deficit of USD 5,084 million. China was the second largest trading partner for the Philippines with 10.9% export share and 16.4% import share.

Malaysia has come into conflict with China and has stepped up patrols in the South China Sea to increase national security. Trade transactions between Malaysia and China reached a volume of US $ 59,304 million, down 7% compared to the previous year. Malaysia's trading operations with a Chinese partner fell sharply, exports fell 8% from $ 28,222 million to $ 26,062 million, imports fell by 6% from US $ 35,322 million to $ 33,242 million. The trade balance was negative with a deficit of USD 7,179 million. China remained an important trading partner for Malaysia, accounting for 19% of total imports, even though trade transactions declined. At the same time China was the second most important export partner.

Indonesia has strengthened its military capabilities and threatened China with an international court. Foreign trade between Indonesia and China amounted to US $ 44,457 million. It dropped by 8% compared to the previous year. Export decreased by 15% from USD 17,605 million to USD 15,046 million and imports decreased by 4% from USD 30,624 million to USD 29,411 million. The balance of trade represented a deficit of USD 14,364 million. China was the most important import partner for Indonesia (with a share of 20.5% of total import volume) and the third largest export partner (with a 10% share of total exports).

For 2016, GDP was produced by the ASEAN Member States at US $ 2 648 068 million. The volume of exports amounted to USD 1,141,118.1 million and imports amounted to USD 1,079,166 million. The ASEAN countries reached a trade surplus of US $ 61,952 million. The balance of trade in total GDP was 2.34%. Economic performance indicators of ASEAN countries and China are shown in Table 6.

Table 6. GDP and trade balance of selected ASEAN countries and China in 2016 million USD
Source: World Bank and WTO, own processing)

Year	**2016**				
Country	**GDP**	**Export**	**Import**	**Saldo**	**Trade volume in % GDP**
Brunei	13 301	4 960	3 090	1870	14.06%
Malaysia	343 939	189 414	168 392	21022	6.11%
Philippines	284 476	56 313	86 290	-29977	-10.54%
Vietnam	164 104	176 784	174 231	2553	1.56%
China	9 505 156	2 098 161	1 587 431	510730	5.37%

The total volume of foreign trade between ASEAN and China amounted to US $ 368,025 million. It grew by 6% compared to the previous year, with exports totaling US $ 143,518 million and imports of US $ 224,507 million. The negative trade balance reached a deficit of USD 80,989 million. Exports of commodities to China increased by 7% year-on-year and imports of Chinese products increased by 6%.

By a decision of the International Court in The Hague, Chinese claims in the South China Sea were invalid and the country had to leave the occupied islands. PRC officials have ignored court rulings and strengthening positions on the islands has led to tension escalation.

In particular, the Philippines was deeply concerned by China's behavior. International trade between the Philippines and China reached a total of US $ 22,108 million, up 24% from the previous year. Export transactions decreased by 3%, from USD 6,393 million to USD 6,192 million. The import transactions grew rapidly, by 39%, from USD 11,477 million to USD 15,916 million. Despite the decline in export transactions, China's share of total exports to the Philippines increased compared with 2015. The share of total imports increased by more than 2%. The negative balance of the Philippine trade balance amounted to USD 9,723 million. China was the fourth most important export partner for the Philippines, with a share of 11% of its total volume and with 18.5% of its total volume being the first major import partner. Changes in security resulting from China's decisions did not affect economic cooperation between countries.

3. IMPLEMENTATION OF NEW POLICIES TO INCREASE SAFETY LEVEL AND ECONOMIC COOPERATION

ASEAN and China's international trade relations are under intensive development, with the exception of 2008, as a consequence of the global economic crisis. The trade balance has increased from $ 60bn to $ 370bn since 2016 since 2003. An important milestone was the creation of a free trade zone between ASEAN and China in 2010. The current tensions arising from territorial disputes therefore have no impact on economic cooperation. In the area of security, however, there is an escalation of tensions in the Spratly and Paracel Islands, the definition of exclusive economic zones and the freedom of movement and exploitation of mineral resources in the South China Sea.

ASEAN and China's international trade relations are under intensive development, with the exception of 2008, as a consequence of the global economic crisis. The trade balance has increased from $ 60bn to $ 370bn since 2016 since 2003. An important milestone was the creation of a free trade zone between ASEAN and China in 2010. The current tensions arising from territorial disputes therefore have no impact on economic cooperation. In the area of security, however, there is an escalation of tensions in the Spratly and Paracel Islands, the definition of exclusive economic zones and the freedom of movement and exploitation of mineral resources in the South China Sea.

The most intense disputes are about the Spratly and Paracel Archipelago, which are wholly or partially claimed by individual actors. The whole of Spratly's archipelago claims China and Taiwan within the line of nine lines, but also Vietnam, the Philippines, Malaysia and Brunei claim some islands. The Paracel Archipelago is claimed by China, Taiwan and Vietnam. Chinese, Taiwanese and Vietnamese claims are documented by historical documents, while the Philippines, Malaysia and Brunei are claiming on the basis of the boundary of the exclusive economic zone.

Claims based on historical relationships are not sufficiently conclusive. They do not provide credible information about permanent ties to the disputed territory. Claims based on the exclusion of exclusive economic zones are not specifically addressed in UNCLOS in the case of overlapping EEZ borders. It is assumed that the International Court of Justice relies on the agreement and cooperation of states within the region, even though states have already started to prove their claims by modern principles. The main principle is the occupation and effective control of the claimed territory. The Spratly Islands are currently partly occupied by China, Taiwan, Vietnam, Malaysia and the Philippines, Paracel Islands are occupied only by China. Occupational policy causes tension escalation and negatively affects the level of security in the region.

Reducing tensions could be achieved by limiting securitization, stopping the occupation policies of the disputed islands and strengthening the confidence of actors and joint military co-operation in the region.

The creation and legalization of an exclusive economic zone in the United Nations Convention on the Law of the Sea in 1982 extended the maritime rights of coastal States to 200 nautical miles from the base line.Some states are making territorial claims in the South China Sea on the basis of an EEZ that overlaps lines. An appropriate solution would be to apply a UN exemption to EEZ that would exclude all islands in the South China Sea from zone delimitation. States would only be allowed to define an economic zone at a maximum distance of 200 nautical miles from their coast. The freedom of movement in maritime, air and seabed research should be based on the development of cooperation and trust, based on the discussion and development of cooperation in finding a way to divide the mineral resources. Two options are available. The first solution is based on a fair distribution of raw materials in the same proportion, given the number of participants in the dispute, ie six identical shares. The second option would be based on defining a certain ratio to the total of mineral wealth that would allow a joint exploration of the seabed and subsequent mining. Applying the theoretical approaches of the Copenhagen school, it will probably be the most important recommendation for the international community and the global security hegemony not to engage in the region but only to oversee adherence to internationally agreed rules.

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THE EFFECTIVITY AND EFFICIENCY OF OFFICIAL DEVELOPMENT ASSISTANCE IN DRC IN PERIOD 2006 – 2016

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Abstract: *The article deals with the analysis of the Official Development Assistance on the road transport infrastructure development in choosen countries Central and East Africa. Traffic capacity and its connectivity is likely to play an important role not only economic development, but also to combat the illegal trade in minerals, but also a higher level of willingness of donors to invest in the countries analyzed.*

Road network evaluation in devitality. From the calculated data it is obvious that the highest deviatility reached Maniema province with 3.16. It is caused by the insufficient road connection. The roads have been destroyed during the long lasting turmoil in eastern part of the country. Moreover Maniema is the most isolated province in the country. The connection among its cities as well as with other provinces is very poor. The second worst province is Sud-Kivu neighbouring to Maniema with deviatility 2.32. The province is characterized with low road density in respect to its area and by greater number of hills. On the other hand the province with lowest deviatility 1.37 is mineral rich province Katanga. This number is caused by the location of cities and good roads density.

The lowest accessibility reached Orientale province mainly because of its large area, moreover it lies on southeast which is affected by the continuous crimes and fights thus the connection among cities is poor. Despite the prolonged shape of Kasai-Oriental province, the accessibility is the lowest from the nine analysed provinces. This is caused by the cumulation of the most significant hubs in a very small area in the south. The connection between southern and northern part is via less important roads and by air transportation to the city Lodja in the southern part of the province. The Nord-Kivu is province with second lowest accessibility, due to its small area and concentration of the hubs in eastern part of province.

Connectivity has been used as other indicator of the DRC road network efficiency. It indicates the level of connection among communication hubs. It is obvious that the average connectivity is 0.5. It can be observed that the best connectivity has Bandundu province and Orientale province. There is high density of the national and regional roads in surrounding of the most significant transportation hubs; to observe only national and regional roads was set as an input condition to the measuring of connectivity. On the other hand through the Maniema province only one National road passes as well as it passed through the Nord-Kivu province. However the density of roads in Bas-Congo is relatively good, the roads either did not fulfilled the conditions or they connect the hubs that were not analysed.

Keywords: *cooperation, transport network, infrastructure, Official Development Assistance, DRC*

1. INTRODUCTION

The authors concerns with the ODA provided by the member states of Organization for the Economic Cooperation and Development (OECD) (Sagasti, 2006). The ODA provided to the Democratic Republic of Congo is analyzed. Despite the ODA, the road infrastructure and network is examined.

The aim of the article is to analyze the transport infrastructure and the development of the transport infrastructure capacity and quality in the connection with the Official Development Assistance provided. The evaluation of the road network is, done using the accessibility, connectivity and circuitry indicators. Based on the results from analysis and the author´s calculations the recommendations how to improve the situation are suggested.

2. METHODOLOGY

The road network is evaluated by following four morphological sings: deviatility, accessibility, density, and connectivity.

Deviatility is common that communications do not have linear direction but more or less deviate from it, consequently the connection among various transportation hubs is frequently not linear. This sinuosity of transportation networks is called *deviatility* . Deviatility could be expressed as ratio between the length of communication among chosen transportation hub (lk) and length of direct connection among them (lp). The deviatility (ds) is expressed by following formula (Brinke, 1999) [1]: $d_s = \frac{l_s}{l_p}$. If lk = lp then ds = 1, therefore the deviatility could be equal to 1 or it could be higher than one ds ≥ 1. It means that the deviatility is higher the more it deviates from 1. According to Brinke (1999) deviatility of communication network is influenced by many factors. Accessibility is closely related to hierarchy of communications. If the road or railnetwork is observed more deeply it will be found out that some communications are more important than the others. Those usually connect more important and bigger municipalities and commonly have lower deviatility. In case of road network the roads of 1st grade have lower deviatility than the roads of 2nd grade connecting less important places. The same situation could be observed on hubs. Some of them have higher amount of connections and more communications pass through them. It is obvious that in communication network some meaning-grading system of communication and hubs exists – this is the hierarchy of connections and hubs. (Brinke, 1999)[1].

The connectivity could be expressed as ratio of real number of connectors among transportation hubs (Sd) to maximal number of connectors among transportation hubs (Smax): $K = \frac{S_d}{S_{\max}}$. Minimal and maximal number of connections among hubs (S) is dependent on the number of hubs (u). The minimal number of connections is always lower by one that the real amount of hubs, i.e. $S_{\min} = u - 1$; maximal number of connections is then $S_{\max} = \frac{1}{2} ux(u-1)$

The correlation analysis is used to assess the extent to which the Official Development Assistance provided affect the development in the transport network of the Democratic Republic of the Congo.

To assess the extent of the linear dependence of the two components of a continuous random vector, Pearson´s correlation coefficient ρ has been introduced. (Litschmannová, 2011).

$$\rho = \rho(X,Y) = \begin{cases} \frac{cov(X,Y)}{\sqrt{DX \cdot DY}} \\ 0 \end{cases} \qquad DX, DY \neq 0 .$$

Below some of the coefficient characteristics are listed (Litschmanová, 2011):

1. $-1 \leq \rho \geq 1$, the equality is reached only if there is the linear dependence between the random variables X and Y.
2. If X, Y are independent random variables, then $\rho = 0$.
3. If $\rho = 0$, then X, Y are uncorrelated random variables.
4. If $\rho > 0$, then X, Y are positively correlated (if X increases, then Y increases).
5. If $\rho < 0$, then X, Y are negatively correlated (If X increases, then Y decreases).

It is obvious that Pearson correlation coefficient is an appropriate measure of linear dependence of random variables.

Transport and development

Generelly it could be mentioned that in global perspective there are a lot of factors contribute to the economic and social growth, and the mobility is especially important. It could be easily demonstrated that there are huge differences in the availability of transport at the global level. Efficient transport is fundamental component of economic development, globally as well as nationally.

In order to plan accessibility to respond people´s need Howe (1983) defined six core needs as: *1) Health, 2) Education, 3) Markets, 4) Water, 5) Firewood, 6) Other subsistence tasks (principally farming).* (Elis, 1997)

Most rural transport is on an informal path and track network which connects villages, farms and sources of water. The highest burden is laid on women with regard to collection of water and firewood. Limited access to markets, schools and health facilities is caused by poor accessibility as well. Thereby the people´s productive potential is limited. (Elis, 1997).

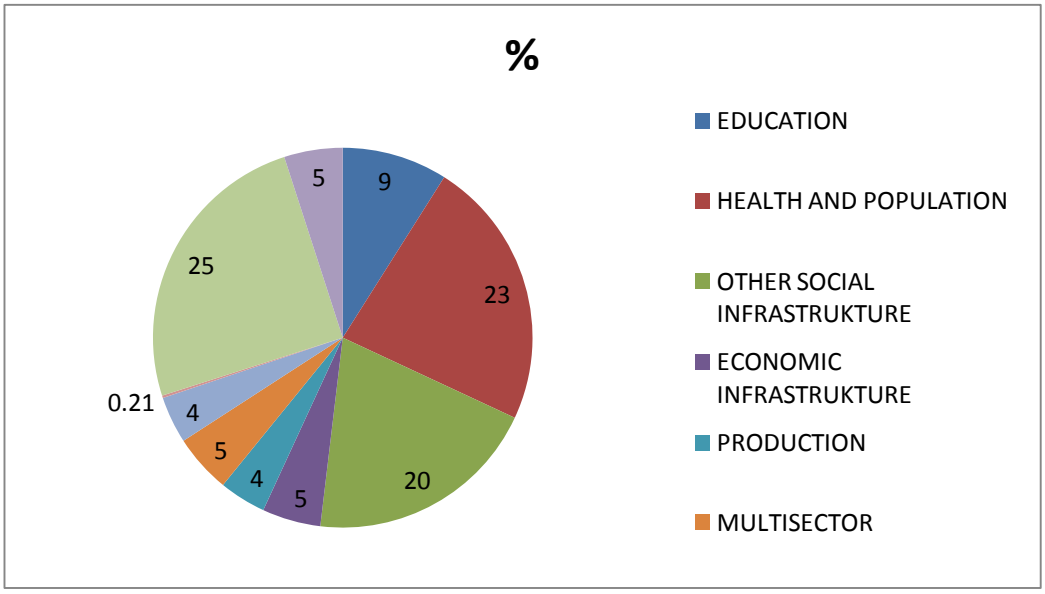
Official Development Assistance in the Democratic Republic of the Congo

The Democratic Republic of the Congo has been among the top 10 recipients of humanitarian assistance in nine of the last ten years. According to OECD statistics ODA reached US$2 107,4 million in 2016. Over half of the money came from the WB, China, the EC, and the UK. ODA increased to US$4,249.27 million in 2011. ODA in 2013 fell to US $ 1.161.57 million. ODA in 2014 reached US $2 400 million. In 2015, the ODA increased to 2 599.0. According to the survey in OECD statistics the most of Official Development Assistance financial sources in DAC flows into the actions relating to the debt 42%, followed by social infrastructure and services 28% where the education; water supply and sanitation belongs to (see Graph 1). The third largest sector where ODA flows is humanitarian aid with 20%. The transport and communication belongs together with energy into the economic infrastructure and services. In the frame of the economic infrastructure and services into the transportation and communication flows only 5%. The small portion of ODA assigned into transportation in DRC could be caused by the pervasive conflicts and thus by the unsatisfactory social conditions.

Therefore there is considerable need of the government to invest into other sectors than is the transportation.

Table 1 shows the distribution of Official Development Assistance in the transportation sector. The biggest portion of money is flowing into the road transport. The government of the DRC realizes the necessity of the developed road network in order to achieve stable development of the country. Several projects to improve the infrastructure are supported and funded by donors, mainly by the World Bank, European Union and China. The water transportation is very common in DRC; it is a cheap mean of transport therefore small portion of ODA is flowing to this sector to improve the standards.

The rail and air transportation sector received only small portion of ODA. It could be caused by the necessity to invest into the road sector because of the poor condition of the roads.



GRAPH 1: ODA in sectors, 2015-2016 (%)
(Source: OECD/DAC 2, edited by authors)

Table 1: ODA in transportation sector, 2005-2013 (milion US$)
(Source: OECD/DAC 2, edited by authors)

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Transport and Storage, total	5,53	8,63	8,37	12,02	30,56	42,56	44,43	52,89	44,82
Transport policy and administration	2,08	4,04	3,64	0,31	0,13	0,01	NA	1,19	0,11
Road transport	3,45	4,55	4,69	11,67	29,93	39,5	37,92	50,64	44,52
Rail transport	NA	NA	NA	0,04	0,31	2,6	6,42	0,21	0,02
Water transport	NA	NA	0,02	0,01	0,04	0,31	0,07	0,02	0,01
Air transport	NA	NA	0,02	NA	0,15	0,03	0,02	0,83	0,16

Transport infrastructure in DRC

The transport infrastructure in the Democratic Republic of the Congo is probably the most challenging in the Africa. The transportation has always been difficult due to vast geography, and low population density. As a result of conflicts roads and railways are obliterated. Since 2003 when the peace was established, some progress has been made in terms of infrastructure development.

Road transport

Lack of adequate roads is a major problem influencing the development of the almost all area of DRC. Just a few roads remain in good condition. Support for foreign investors allowed reconstructed road network in some areas. Since the end of the conflict, reconstructing the road network has been a toppriority. The money from donators covers a lot of major corridors linking Kinshasa and Lubumbashi. (Foster & Benitez, 2011) From ten provincial principal towns only two (Matadi, Bandundu) are connected with the capital city Kinshasa by a road.

Two of them are accessible by water (Kinsangani, Mbandaka) and the remaining six (Kananga, Mbuji Mayi, Lubumbashi, Kindu, Goma, Bukavu, and Kisangani) by air. (Logistic Capacity Assessment 1, 2014)

The road network in DRC consists of 58,358 km of national road; 86,615 of rural roads; and 7,400 km of urban road. According to estimates, around 5% of the national roads are sealed (Logistic Capacity Assessment 1, 2016). As per the official classification the road network could be divided into four main official categories. These are *1) national roads, 2) priority regional roads, 3) secondary regional roads,* and *4) local roads*. Since the most of the roads are damaged or inexistent this subdivision remains theoretical. The Observatorie National des Transports claims that the entire national road network in the Democratic Republic of the Congo was in 2011 about 152,400 km long, with 21,136 km of national roads; 20,124 km of priority regional roads; and 17,245 km of secondary regional roads. (Observatorie National Des Transport, 2011).

The Table 2 provides information about the length of the national roads, priority regional and secondary regional roads in the eleventh provinces of DRC.

Table 2: Roads length in DRC by province, 2011 (km)
(Source: Observatorie National Des Transport)

Province	**National roads**	**Priority regional roads**	**Secondary regional roads**	**Total km**
Bas-Congo	1370	891	869	**3130**
Bandundu	2215	3566	3160	**8941**
Équateur	2970	2781	3158	**8909**
Orientale	3699	3484	3075	**10258**
Sud-Kivu	1037	873	0	**1910**
Nord-Kivu	833	524	389	**1746**
Maniema	1071	1183	1543	**3797**
Katanga	4258	4054	2958	**11270**
Katanga	4258	4054	2958	**11270**
Kasaď Oriental	1446	1627	1234	**4307**
Kinshasa	252	NA	NA	**252**
Total	**21136**	**20124**	**17245**	**58505**

Around 20,000 bridges and 325 ferries occur in the country; majority of them have not been replaced or reconstructed at all. Over 90% of bridges are in poor condition. In the Table 5 the distribution of the bridges by province and type in 2011 can be seen. (Logistic Capacity Assessment 1, 2014)

Table 3: Number of bridges by province and material, 2011
(Logistic Capacity Assessment 1, edited by authors)

Province	**Wooden**	**Metallic**	**Reinforced concrete**	**Total**
Bas-Congo	144	129	84	357
Bandundu	157	82	59	298
Équateur	7	109	7	123
Orientale	112	123	95	330
Sud-Kivu	77	47	20	144
Katanga	17	110	81	208
Kasaď Oriental	8	57	13	78
Kasaď Occidental	23	40	13	76
Kinshasa	0	2	12	14
Nord-Kivu	81	18	25	124
Maniema	65	33	36	134
Total	**691**	**750**	**445**	**1886**

In the Table 4 the condition of national roads could be observed. The term "National roads" covers the National roads, Priority regional roads, and the Secondary regional roads. (Logistic Capacity Assessment 1, 2014)

Table 4: State of national roads by province, 2013 (km)
(Logistic Capacity Assessment 1, edited by authors)

Province	**National roads**	**Good**	**Fair**	**Poor**	**Unknown**
Bas-Congo	2592,3	842,5	326	418,5	1005,3
Bandundu	8286,25	1380,2	606	1510,5	4789
Equater	8407,2	639,7	470,3	2602,2	4695
Kasad' Occidental	3842,5	233,6	340	1765	1504
Kasad' Occidental	3842,5	233,6	340	1765	1504
Katanga	10851,4	1917	1193,4	2173,5	5567,5
Kinshasa	367	341,7	18,1	7,2	NA
Maniema	3365,5	285	288,1	927	1865,4
Nord-Kivu	1526,6	668,3	476	289,5	92,8
Orientale	10973,4	1326	897	2398	6352,4
Orientale	10973,4	1326	897	2398	6352,4

Deviatility

Bandundu province has been chosen to demonstrate the calculation of the shortest road distances and direct distances among five biggest cities in the region. Deviatility is then calculated as the shortest road distance divided by the direct distance among the cities. Table 5 provides an overview of road network distances among chosen cities in Bandundu province and their sum.

Table 5: Road network distance among chosen cities of Bandundu province (km)
(Source: Google Earth, edited by authors)

	Bandundu	**Kikwit**	**Idiofa**	**Bulungu**	**Kenge**	**Sum**
Bandundu	X	393	545	313	439	
Kikwit	393	X	155	86,1	267	
Idiofa	545	155	X	238	419	
Bulungu	313	86,1	238	X	242	
Kenge	439	267	419	242	X	
Sum of length	1690	901,1	1357	879,1	1367	6194,2

Table 6 illustrates direct distances among chosen cities and their sum as well as the deviatility of each city. The average deviatility was then used to calculate average deviatility of DRC.

Table 6: Direct distance among chosen cities of Bandundu province (km), deviatility
(Source: Google Earth, edited by authors)

	Bandundu	**Kikwit**	**Idiofa**	**Bulungu**	**Kenge**	**Average**
Bandundu	x	246	305	192	166	
Kikwit	246	x	86	59	198	
Idiofa	305	86	x	119	283	
Bulungu	192	59	119	x	175	
Kenge	166	198	283	175	x	
Sum of length	909	589	793	545	822	3658
Deviatility	1,86	1,53	1,71	1,61	1,66	1,68

The Table 7 provides overview of values of deviatility for all analysed regions. The values were calculated in the same way as the values for Bandundu region.

From the calculated data it is obvious that the highest deviatility reached Maniema province with 3.16. It is caused by the insufficient road connection. The roads have been destroyed during the long lasting turmoil in eastern part of the country. Moreover Maniema is the most isolated province in the country. The connection among its cities as well as with other provinces is very poor. The second worst province is Sud-Kivu neighbouring to Maniema with deviatility 2.32. The province is characterized with low road density in respect to its area and by greater number of hills. On the other hand the province with lowest deviatility 1.37 is mineral rich province Katanga. This number is caused by the location of cities and good roads density. However the deviatility reached the best value from DRC, the roads are in poor condition.

Table 7: Deviatility for all regions
(Source: Google Earth, edited by authors)

	Deviatility
Bandundu	1,68
Bas-Congo	1,44
Kasai-Occidental	1,56
Kasai-Oriental	1,43
Katanga	1,37
Maniema	3,16
Nord-Kivu	1,38
Orientale	1,88
Sud-Kivu	2,32

Total deviatilita States, Kenya, Tanzania, Uganda and DRC

Table 8: Deviatility for choosen countries
(Source: Google Earth, edited by authors)

	Deviatility
Kenya	1, 23
Tanzania	1,36
Uganda	1,34
DRC	1,8

Accessibility

Accessibility as one of the most important indicators. To measure the accessibility the distance among the cities is used. Results are expressed in kilometres. In the Table 9 the overview of shortest road network distance among the hubs is measured, the values are summarized, followed by the calculation of accessibility expressed in kilometres.

Table 9: Road network distance among chosen cities of Bandundu province, accessibility (km)
(Source: Google Earth, edited by authors)

	Bandundu	**Kikwit**	**Idiofa**	**Bulungu**	**Kenge**	**Average**
Bandundu	x	393	545	313	439	
Kikwit	393	x	155	86,1	267	
Idiofa	545	155	x	238	419	
Bulungu	313	86,1	238	x	242	
Kenge	439	267	419	242	x	
Sum of length	1690	901,1	1357	879,1	1367	
Accessibility	338	180,22	271,4	175,82	273,4	247,77

The calculation of accessibility is illustrated on the Bandundu province. At first, the shortest possible road distances among five biggest hubs in the province were measured and summed up for each city, consequently divided by the number of analysed hubs in the road network, i. e. five. It is obvious from the Table 10, the accessibilities vary significantly from region to region. Considerable role plays also the percentage of mountains, rivers, natural parks and forests. The worst accessibility reached Orientale province mainly due to large area, moreover it lies on southeast which is affected by the continuous crimes and fights thus the connection among cities is poor. Despite the prolonged shape of Kasai-Oriental province, the accessibility is the lowest from the nine analysed provinces. This is caused by the cumulation of the most significant hubs in a very small area in the south. The connection between southern and northern part is via less important roads and by air transportation to the city Lodja in the southern part of the province. The Nord-Kivu is province with second lowest accessibility, due to its small area and concentration of the hubs in eastern part of province.

Table 10: Accessibility for all regions (km)
(Source: Google Earth, edited by authors)

	Accessibility
Bandundu	247,77
Bas-Congo	192,99
Kasai-Occidental	202,38
Kasai-Oriental	95,05
Katanga	244,59
Maniema	410,82
Nord-Kivu	140,02
Orientale	615,68
Sud-Kivu	266,62

	Accessibility
Kenya	326, 16
Tanzania	429, 36
Uganda	260, 88
DRC	268,44

Connectivity

Connectivity has been used as other indicator of the DRC road network efficiency. It indicates the level of connection among communication hubs

Table 11: Connectivity for all regions and the average value for DRC
(Source: Google Earth, edited by authors)

	Sd	Smax	Connectivity
Bandundu	7	10	0,7
Bas-Congo	4	10	0,4
Kasai-Occidental	6	10	0,6
Kasai-Oriental	6	10	0,6
Katanga	5	10	0,5
Maniema	4	10	0,4
Nord-Kivu	4	10	0,4
Orientale	7	10	0,7
Sud-Kivu	6	10	0,6

From Table 11 it is obvious that the average connectivity is 0.5. It can be observed that the best connectivity has Bandundu province and Orientale province.

There is high density of the national and regional roads in surrounding of the most significant transportation hubs; to observe only national and regional roads was set as an input condition to the measuring of connectivity. On the other hand through the Maniema province only one National road passes as well as it passed through the Nord-Kivu province. However the density of roads in Bas-Congo is relatively good, the roads either did not fulfilled the conditions or they connect the hubs that were not analysed.

Table 12: Connectivity for all regions and the average value for DRC
(Source: Google Earth, edited by authors)

	Connectivity
Kenya	0,7
Tanzania	0,9
Uganda	0,6
DRC	0,5

Correlation of ODA and transport network indicators in DRC

To calculate the relationship among Official Development Assistance and the indicators related to the transport infrastructure the data from World Bank database have been used. The correlation coefficient ranges between -1 and +1. If the value of correlation is +1 it means perfect positive correlation, i.e. as one variable move, either up or down, the other variable moves in the same direction. Conversely, value -1 means perfect negative correlation, i.e. as one variable move in either direction, the second variable moves in opposite direction. If the value is 0, there is no relationship between variables. The overview of analysed correlation is illustrated in the Table 18 below.

Table 13: Correlation of ODA and transport infrastructure indicators
(Source: Author´s own work)

	ODA
Railway transport	
Passengers carried	-0,479
Goods transported	-0,4
Air transport	
Passengers carried	0,942
Registered carrier departures	0,988
Water transport	
Liner shipping connectivity index 0,	617
Road transport	
Energy consumption	0,894

As the level of transport infrastructure in DRC is very poor and almost no current data exists, the most suitable indicators were used to set the relationship among them and the Official Development Assistance. Strong relationship can be observed in case of air transport. It can be seen that as the ODA has been increasing till 2012, subsequently, the level of ODA has changed, as already described. The number of passengers carried and number of goods transported has been increasing as well. On the other hand in 2013 the decrease in ODA came and consequently the number of passengers and goods declined as well. The decrease in ODA provided could be caused by the fighting between the March 23 Movement and the government in Nord-Kivu province.

In 2012 the M23[1] rebels took control of Goma where the national airport islocated. Thus the level of air safety is worsening and naturally there is a decrease in number of carried passengers. Strong positive relationship occurs between the road energy consumption and ODA provided to the road sector.

It is in accordance with government plans to invest into the road sector and rehabilitate the road infrastructure. The government also relies, inter alia, on the loans that could be secured by Chinese banks.

On the other hand negative relationship not very strong could be seen in case of railway infrastructure. The transportation via rails is more expensive then when the road is used; moreover the ODA provided into this sector is insufficient.

3. RECOMMENDATIONS

Based on the analysis done in the thesis it is obvious that the transport infrastructure of the Democratic Republic of the Congo is in critical condition. Continuous conflict damaged most of the railway and road networks and the air transport suffers from poor security. However some progress since the official return of peace in 2003 has been made, the situation mainly in eastern part of the country remains critical. Road network in the Democratic Republic of the Congo remains challenging due to low population density and extensive river network. Moreover the vast area is covered by tropical forests, rivers are crisscrossed, thus the road construction is complicated and high amount of bridges is needed. Due to the vast area DRC have to spend huge amount of money only to keep the infrastructure in usable condition. As it was mentioned previously in the text without ensuring peace in the country the development of the road infrastructure is almost impossible or at least very difficult. Continuously after the stabilizing the country the efficient plan for financing the road network reconstruction and maintenance should be devised. The roads damaged during the conflicts should be rebuilt to restore the connections among hubs and thus ensure the basic needs for the citizens.

According to several sources dealing with African infrastructure the price for goods transportation is very high in DRC. The improvement of the road conditions, decrease in deviatility and better accessibility should theoretically lower the prices of road transportation. Additionally, improvements in governing the trucking industry should be done and precise rules should be set. High level of corruption limits the effective use and allocation of funds and Official Development Assistance. It is highly recommended to combat the corruption, set the monitoring mechanisms, and the use of money from loans, funds and donors should be transparent to all. Because of the crisscrossing rivers the road transportation is problematic. Very often the roads end at the river bank because the bridges either do not exist or are in unusable condition. Therefore it is recommended to focus the projects on the reconstruction of bridges and to build new ones in crucial places. Further the road network should be more frequently combined with water transportation in terms of ferry use. The river is major obstacle mainly in the Équateur where the Northern and Southern parts of the province are divided by Congo.

Finally, the road infrastructure development the law and regulatory conditions could be analyzed and the private sector could be involved into the financing.

Official Development Assistance

In the analyzed countries need to integrate the planning of road infrastructure development with economic strategy and regional development. Despite the adoption of various strategies for road infrastructure development and maintenance, the level of damage to the road transport infrastructure is high. The fact is due mainly to the lack of allocated funds, low capacity suppliers and poorly set control mechanisms.The Democratic Republic of Congo has been among the top ten recipients of Official

Development Assistance in last years, the country is highly dependent on the aid. The financial resources are by the highest share used to the actions related to the debt, and social services to provide basic services to the citizens of DRC.

As a consequence the resources flowing into the transportation sector are not sufficient enough, however the amount is increasing. The biggest share of ODA in terms of transport is allocated to the road transport. The government realizes the necessity of improvement the condition of roads destroyed by the continuous wars in order to achieve stable development. Because there is strong relationship between the security and the development of infrastructure it is highly recommended to improve the security levels and restore the peace as mentioned in previous subchapter. There is as well strong interdependency among the different kinds of the transportation. The government and donors should realize the necessity of implementation such projects interconnecting all kinds of transportation. Further the cooperation among government, donors, and private subject should be developed and coordinated. It is very important to ensure the positive socio-economic impact of the realized projects and their sustainability. Moreover the environmental impacts of the project should be analyzed before the implementation. Further the author would recommend allocating more resources among the rail and air transport. Because of the vast area of the country the domestic air transportation is integral part of travelling around the DRC. As mentioned before the security of this kind of transport remains very poor, as well as the facilities are in bad condition. The railways are the most important mean of transport mainly in such parts of country where the minerals are exploited. To attract the donors the government of DRC should develop effective and consistent legislation. Further it should work on improvement of the country profile.

It is recommended to create strict rules when fighting the corruption because it negatively influences the amount of ODA and the money are not reaching the target projects. Finally the ODA should aim to impact the poorest 20% of people living in developing countries.

4. CONCLUSION

The Democratic Republic of the Congo is the second largest country in Africa. The country has been challenging the continuous wars and as a consequence the transport infrastructure quality is poor. The most affected by the turmoil are roads and railway infrastructure, from the poor security suffers the air transport as well. On the other hand the country is endowed with thousands of kilometres of navigable waterways. Traditionally the water transport has been the dominant way of moving around the country. According to World Bank the need to invest into infrastructure is in DRC one of the highest from whole Africa. According to the author the biggest obstacle to build sufficient infrastructure is the low level of security. The country is endowed with precious minerals which bring about persistent fights.

To use its potential it is needed to improve the security level and brought to an end this turmoil. Only then the infrastructure could be reconstructed and the condition of roads and railways could be maintained.

Further barrier is the high corruption. When there are developing programmes the money are stolen at most cases. Moreover the government of DRC does not fulfil its functions. However some progress since the restored peace in 2003 has been made, the situation remains critical mainly in eastern part of the country. Based on the analysis the author has found out that DRC is highly dependent on the Official Development Assistance. DRC has been among the top 10 recipients of humanitarian assistance in nine of the last ten years. The aid is necessary mainly to functioning of basic social services, and the financial sources flows into the actions relating to the debt as well. Contrary, only 3% of overall ODA provided to the country flow to the infrastructure.

From infrastructure sector the highest share of money is invested into the road network. In chapter Recommendation the author proposed some recommendations that should lead to improvement of the all types of transport infrastructure in DRC, i.e. road, railway, water, and air infrastructure. Some suggestions that should increase the efficiency of Official Development Assistance allocation and use has be proposed as well as the necessity to improve the security level has been addressed.

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INDUSTRY PERFORMANCE EVALUATION OF LISTED MILITARY ENTERPRISES BASED ON MINDS MODEL

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Abstract: *This paper takes 25 listed military enterprises as the research sample. According to the sample enterprise 2011-2015 years of financial data, the comprehensive technical efficiency, pure technical efficiency and scale effect are calculated by using the MinDS model, determine the size of the sample enterprise revenue stage, and in combination with the original data on the level of its real performance evaluation of the industry. The results show that: the overall performance level of the sample enterprise is not high. There are some differences between the performance level of different industries. It is suggested that the sample enterprises through reform and optimize the industrial structure, to achieve innovation driven development.*

Keywords: *MinDS model; military enterprises; performance evaluation*

1. THE ISSUE RAISED

Military enterprises as an important carrier of civil military integration depth development, shoulder the dual mission of improving national defense science and technology strength and promote the development of the national economy, that is the front position of state-owned enterprise reform. In the past, due to its special properties, military enterprises had to face some problems, such as the lack of effective competition in the industry, the administrative power to intervene, and other issues, that affected the power of enterprise reform to a certain extent. With the introduction of "*Guiding Opinions on Promoting The Shareholding System Reform of Military Enterprises*", "*Interim Measures for the Implementation of the Shareholding System Transformation of Military Enterprises*", "*Interim Provisions on the Administration of the Intermediary Institutions Involved in the Reform and Listing of Military Enterprises and Institutions*" and a series of policies, military enterprises began to take the initiative to adapt to the laws of market economic development, and promote enterprise reform and listing and financing, basically established a modern enterprise system. As of 2016, Chinese military asset securitization rate has exceeded 40%, military enterprises gradually become a real market players. Now, facing the new normal development of the national economy, national defense science and industry of listed enterprises are in the development trend? Real performance level of each industry is to achieve the desired standard? This has become a very concerned problem for decision makers.

For the performance evaluation of China's listed military enterprises, many scholars have done related research. Wu Qing (2007) used super efficiency DEA model to analyze the operational efficiency of listed military enterprises from the angle of input and output efficiency. The conclusion was that the operating conditions of listed military enterprises were mainly determined by the enterprise's own technological advantages, as well as the degree of conversion of technological advantages. Zhang Yong et al. (2014) used the DEA model to analyze the problems and causes of human, financial, scientific, technological, information and other resources in the western region, and gave the countermeasures and suggestions to improve the efficiency of civil military integration in the western region. Zhou Bin (2015) based on VRS conditions, used non - angle SE-SBM model to evaluate the economic efficiency of military and civilian integration industry demonstration base. He proposed that we should pay attention to the relationship between the leading industries and the non-leading industries, taking into account the continuous development of traditional industries and strategic emerging industries. Wang Haitao and Gu Chunwei (2016) studied the production efficiency and the influencing factors of China's military listed enterprises from 2005 to 2014 by using the DEA-Tobit two stage analysis method. The result of the study was that the value of pure technical efficiency was not high, the production efficiency difference between enterprises was more and more big, and the scale wasn't economic and so on. Zhang Ming and Zhang Yaya (2016) used DEA-Malmquist index to measure the efficiency of listed military enterprises restructuring. The results showed that before and after the reform of listed military enterprises, the upgrade in the allocation of resources, resource efficiency and other aspects was not obvious. They suggested that the military enterprises should continue to improve the efficiency through scientific and technological innovation and management and other measures in the process of restructuring.

On the basis of previous studies, this paper takes the 25 national defense science and industry listed enterprises as the research sample, and extracts the financial data of the sample enterprise 2011-2015. MinDS model is used to evaluate the performance level of the sample enterprises in order to provide some reference value for the reform of military enterprises.

2. THE INTRODUCTION OF DATA ENVELOPMENT ANALYSIS AND MINDS MODEL

2.1 **The introduction of Data Envelopment Analysis**

Data Envelopment Analysis (DEA) is a non-parametric technique efficiency analysis method which is used to compare the Decision Making Unit (DMU). It was first proposed in 1978 by Charnes, Cooper, and Rhodes in the United States, so the first model of DEA was named CCR model (Charnes A, et al., 1978). Technical efficiency refers to the extent to which the production process of a production unit reaches the technical level of the industry that reflect the level of the technical level of a production unit. Based on the assumption of constant returns to scale (CRS), the technical efficiency derived from the CCR model includes the component of scale efficiency (SE), which is often called comprehensive technical efficiency (TE). In 1984, Banker, Charnes and Cooper proposed a DEA model called BCC model based on Variable Returns to Scale (VRS).

The technical efficiency derived from the BCC model excludes the impact of the scale economy, so it is called pure technical efficiency (PTE). The BCC model also provides a method for calculating the SE. By comparing the TE and the PTE, the SE can be separated, i.e. SE=TE/PTE.

According to the measurement of technical efficiency, DEA model can also be divided into input-oriented, output-oriented and non-oriented. The input-oriented model is to measure the invalid rate of DMU from the input point of view. It focuses on the extent of the input should be reduced under the circumstance of not reducing the output, to achieve the technique effectiveness. On the contrary, the output-oriented model focuses on the extent of the output should be increased under the circumstance of not increase the input, to achieve the technique effectiveness from the output point of view. The non-oriented model is both concerned about input and output.

2.2 The introduction of MinDS model

Due to the measure of the invalid rate from the CCR and the BCC model contain only the proportional reduction (increase) ratio of all input (output), this type of the DEA model is called the radial DEA model. For the inefficient evaluated DMU, the gap between the current state and the ideal state, not only contain the proportional improvement part, but also includes the slacked improvement part. Since this improvement part is not reflected in the efficiency measurement of the radial model, Tone Kaoru(2001) proposed the non-radial Slack Based Measure model (SBM). But the model also has obvious shortcomings. From the point of view of distance function, the projection point of the evaluated DMU is the farthest point from the evaluated DMU on the production frontier. Thus the input or output inefficiency is maximize, rather than minimize the path to the production frontier. To overcome it, Aparicio(2007) and Tone K.(2010) et al made some improvements. They employed the nearest point on the strong efficient frontier as the projection point, and proposed the Minimum Distance to Strong Efficiency Frontier model (MinDS).

The MinDS-CCR model (1) consists of three parts. The first part is the objective functions and the constraint a. The second part is the constraint b. The third part is the constraint. The common purpose of the constraint b and the constraint c is to make the reference benchmark located in a same hyper plane, where M is a positive number large enough. The MinDS model use to represent the technical efficiency of the evaluated DMU. It measured the invalid rate from the point of view of input and output at the same time, respectively as and . Therefore, it is called the non-oriented model. If , the evaluated DMU is high effective that hasn't the weak effective problem of the radial model, so the input-output efficiency reaches the optimal level. On the basis of the MinDS-CRS model (1), the MinDS-VRS model can be got by adding the constraint and the free variable . It should be pointed out that TE/PTE is the Scale Efficiency Score (SE) when using radial distance model, and TE/PTE is the Scale Effect Score (SE) when using non-radial distance model.

3. SAMPLE, INDEX AND DATA DESCRIPTION

3.1 Sample selection

This paper selects 25 listed national defense science and technology enterprises from Chinese Listed Enterprises Association defense industry sector as the DMU. And we obtain the financial data of the 25 enterprises in 2011-2015 from CSMAR. They are: 4 from electronics industry, 4 from aerospace, 6 from heavy industry, 4 from information technology, 3 from remote navigation and 4 from new materials, see Figure 1.

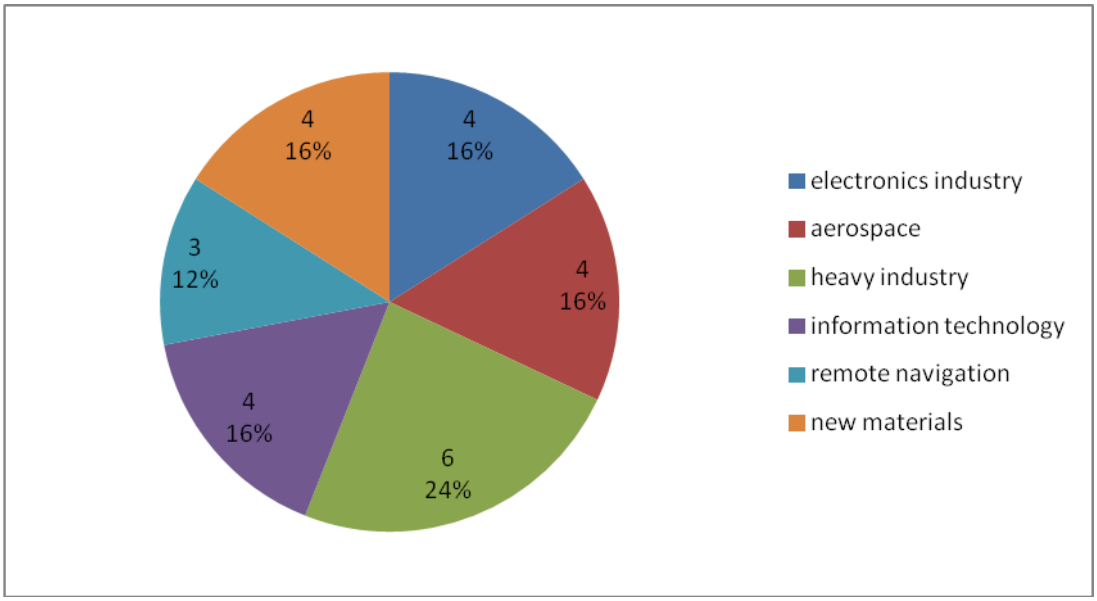

FIG.1 Type and quantity of listed national defense science and technology enterprises

2.2 Evaluation index selection

The input index of this paper is research investment, number of employees, operating costs, other inputs and cash paid for the purchase of fixed assets, intangible assets and other long-term assets. The output index of this paper is gross operating income and total profit. The research investment reflects the enterprises investment in scientific research projects, the number of employees reflects the enterprise investment in human resources, cash paid for the purchase of fixed assets, intangible assets and other long-term assets reflects the enterprise's capital investment, operating costs include the cost of selling goods or services as well as the purchase of raw materials, auxiliary materials fuel and other expenses, other inputs includes financial expenses, selling expenses and administrative expenses. The gross operating income reflects the growth of the enterprises, the total profit reflects the current production and operation efficiency of enterprises, see Table 1.

Table 1 Input index and output index

Input index	research investment (RI)
	number of employees (NE)
	cash paid for the purchase of fixed assets, intangible assets and other long-term assets (CPPFIO)
	operating costs (OC)
	other inputs (OI)
Output index	gross operating income (GOI)
	total profit (TP)

3.3 Data description

As can be seen in the input index from Table 2, the average RI, NE, OC and OI of the sample enterprises were increased year by year. In particular, the average RI was the largest, with an average increase of 36.41%, while the average CPPFIO was decreased with an average decline of 10.47%.

In the output index, the average GOI of the sample enterprises was raising steadily, with an average increase of 2.25%. The average TP was significantly decreased with an average decline of 32.06%.

In detail, except for a slight change in individual indicators in individual years, the situation of electronics industry and remote navigation were relatively steady, with an increase of almost the input and output index year by year. In addition to CPPFIO in the annual reduction, the other indexes of information technology were increased. The operation of the aerospace showed a little volatility that NE, OC, CPPFIO and GOI have a decline in 2015, though the others kept increasing. The volatility of new material was the most obvious. Except for NE and OI, the others all had a different degree of decreased in 2015 after a period of growth, such as CPPFIO had a largest decline of 52.46% in the input index, TP had a largest decline of 203.59% in the output index. The situation of heavy industry was relatively unsatisfactory. Its GOI and TP respectively had an average decline of 4.78% and 66.96%, as well as the input index except for RI were all decreased or stagnant. More details are shown in Table 3.

Table 2 Overall financial data (average value)

year	RI	NE	CPPFIO	OC	OI	GOI	TP
2011	43678544.04	5818.73	725690413.17	5086545153.93	760613425.78	6582009127.04	798853435.02
2012	75011046.36	6512.46	601263826.95	5156956140.55	871989635.45	6518645255.42	591500429.85
2013	88252239.05	6231.31	540963988.93	5675848017.82	948656621.11	7015851623.13	479583232.94
2014	107962677.20	7499.85	509335315.58	5934596685.53	1017132293.56	7264270784.31	370060246.36
2015	144589376.14	7511.85	464129787.89	5984013576.65	1111276494.55	7176322907.57	146148967.24

Note: Calculated in constant 2011 RMB

Table 3 Industry financial data (average value)

Ind.	year	RI	NE	CPPFIO	OC	OI	GOI	TP
Electronics industry	2011	20403163.41	769.50	156592737.66	331402965.77	83729543.24	498529208.74	87317022.51
	2012	73117728.29	1239.50	141375853.06	397315108.93	117116530.29	594760093.78	99171083.59
	2013	43353547.61	1309.50	124567374.15	499289902.14	149056557.35	730776362.95	122175105.23
	2014	64788606.15	1420.75	136761204.44	590604698.80	187831068.80	904317775.11	154946439.31
	2015	97501990.04	1825.75	163936739.29	780551165.30	251353193.48	1217425537.65	215776098.56
Aerospace	2011	13415476.97	6601.75	155231354.02	2899052994.84	320121054.22	3404681511.35	193821633.79
	2012	20899249.64	6555.75	242532446.74	3293235502.08	355009590.52	3850573962.73	218347424.84
	2013	2708987 6.25	6264.25	73783561 8.11	7673623829.03	949649249.26	8934898715.02	417048824.17
	2014	4938568 3.22	13723.25	95726728 0.28	8004708202.60	1028824895.76	9347297175.33	465712389.16
	2015	8852386 5.74	13566.00	86032783 3.36	7256872544.01	1075953379.26	8702246204.50	513974893.83

New materials	2011	11939721.95	1007.50	234349568.24	397017752.56	73765514.70	595074602.49	129534492.93
	2012	18160570.07	1011.00	389993547.95	442738435.12	80709562.46	590647217.62	82211448.36
	2013	12526394.48	1210.50	284225409.05	580536056.52	134011178.92	734665252.99	23659484.46
	2014	15248618.29	1258.75	216107274.30	603529530.28	152138374.35	826369395.43	92286075.84
	2015	11883582.31	1287.00	102735057.88	545235658.20	190157101.15	698465491.86	-95597948.57
Information technology	2011	99373857.04	1034.5	633746400.2	4564637325	785654045.1	5487675729	299905552.8
	2012	16906003.5	4591	500717522.5	5072859510	1023668793	6228514865	329609320.8
	2013	18936674 0.3	5371.75	404964264.6	4916322128	1187554393	6208388975	394224628.4
	2014	22473103 0.7	6151	311617183.9	5587319634	1399114249	7174674600	437162606.9
	2015	27775164 7.3	6151	389541040.6	6278108781	1667192426	8079356489	739028105.2
Remote navigation	2011	10253135 1.53	1991.33	197664189.23	544269223.80	193459206.27	809443438.34	76872469.27
	2012	10607624 9.95	1830.00	204340463.78	518156587.18	244236726.52	825578646.17	115048967.19
	2013	12054415 7.05	2054.33	194897096.23	730364597.36	326001009.29	1175263096.57	165975300.50
	2014	11039765 8.54	2103.33	273232703.62	895297751.00	433719369.00	1484616676.87	213976219.05
	2015	14254269 2.75	2745.33	375657644.56	1181926632.27	539801384.06	1887370620.84	225111181.17
Heavy industry	2011	39381467.31	17777.17	2242456124.40	16287964250.01	2348637206.22	21408883719.08	2929459312.74
	2012	77013103.38	18175.17	1623395694.85	15928613565.66	2594454325.26	20273939356.48	2008534772.95
	2013	12369567 1.62	16293.00	1168611017.38	15088589037.23	2311372832.48	18680906233.84	1347079281.25
	2014	16075256 7.20	16155.50	961871575.06	15375068467.92	2318443780.30	18499618826.34	716746699.21
	2015	21295161 1.55	15583.33	789174702.92	15372864096.16	2385422106.55	17579384879.19	-406286003.79

Note: Calculated in constant 2011 RMB

4. EMPIRICAL ANALYSIS

This paper regards the annual observations of each sample enterprise as a DMU. By using MinDS-CRS and MinDS-VRS model, TE and PTE can be calculated, and then SE can be calculated by TE/PTE. In the calculation results, TE represents the overall production efficiency of the sample enterprises, PTE represents the production technology and management level of the enterprises, and SE reflects the influence of scale economy [2]. Figure 2 shows the trend of the annual average of TE, PTE and SE of the sample enterprises in 2011-2015. Table 4 shows the industry average of TE, PTE and SE of the sample enterprises. Table 5 shows the returns to scale stage of the enterprises in the industry. For limited space, this paper does not list all the annual results of the sample companies.

4.1 The overview

On the whole, the average TE of the sample enterprises is 0.867, with a median of $0.901 from 2011 to 2015. From the result that the median is greater than the average, it can be concluded that the overall production efficiency of most sample enterprises is above the average level, which reflects that the overall production efficiency of the 25 sample enterprises is ideal.

As we can see from Figure 2, in the meantime, the maximum of TE of the sample enterprises is 0.9049 in 2015, followed by 0.9045 in 2012 and the minimum is 0.756 in 2013. The overall trend of TE is roughly "M" font, same as the trend of SE, while the trend of PTE is a weak "Z" font. Specific speaking, from 2011 to 2012, PTE and SE of the sample enterprises are both in growth, and PTE is lower than SE. In 2013, the PTE and SE both drop to the minimum in five years, but the PTE's decline is smaller so that PTE exceeds SE. In 2014, the PTE and SE rise again. The SE achieves the maximum in five years over the PTE again. In 2015, the SE has a decline, but the PTE keeps increasing to maximum in five years over the SE.

The phenomenon shows that the overall production efficiency of the sample enterprises is greatly influenced by the SE. In general, each industry has not been able to completely get rid of the previous development mode that investment driven. However, by observing the trend line (Figure 2) we can find that the overall production efficiency of the sample enterprises is more influence by PTE since 2013. The trend of technical progress and management improvement gradually appears. The reasons for this phenomenon may be the Communist Party of China announced a series of important policies in the third Plenary Session of the 18th CPC Central Committee in 2013. A comprehensive reform of the economy and society, including the reform of the market economy, the reform of state-owned enterprises, etc. has begun. Especially the promulgation of "The Guiding Opinions on Promoting the Shareholding System Reform of Military Enterprises (hereinafter referred to as the *Guiding Opinions*)" has a fundamental influence on the organization structure and production management of the listed military enterprises. It promotes the listed military enterprises to actively adjust the development direction, optimize the industrial structure, and actively adapt to the needs of the army and the new national economic development.

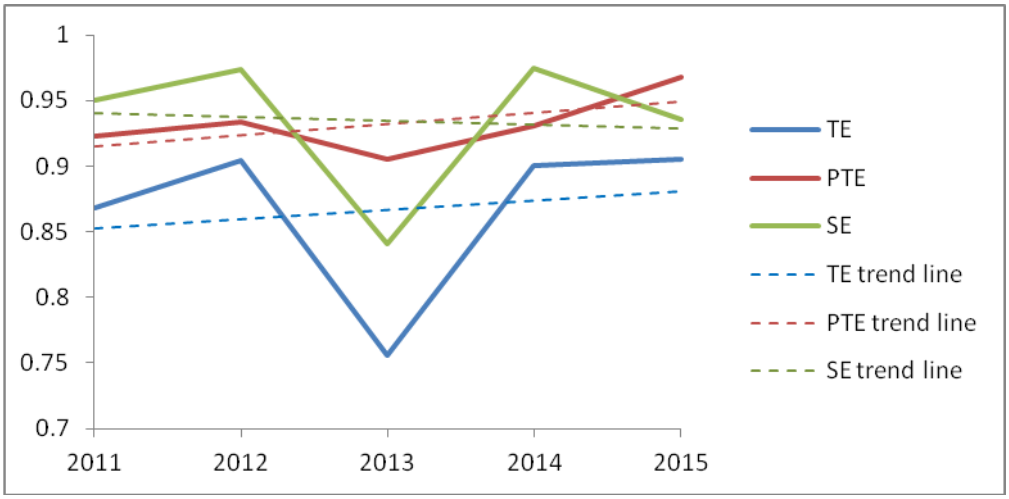

FIG. 2 Overall TE, PTE and SE (average value)

4.2 The industry situation

From the type of industry, the average TE, PTE and SE of the sample enterprises have different degrees of difference in different types.

The average industry TE ranking first is heavy industry. Although its TE only ranks first in 2013 (also the minimum), the rest of the years rank in the top which are never less than 0.85 with a relatively stable trend. Besides, its average SE also ranks first with an industry average of more than 1. On the contrary, its average PTE only ranks fourth in the lower-middle level. This shows that the overall production efficiency of heavy industry is obviously affected by the scale of economic factors, and heavy industry is a typical investment driven industry. It is worth noting that after a period of stagnant growth, its average PTE rises by 11.4% in 2015 and exceeded the average SE. This reflects the industry's emphasis on technological progress and management improvement. The industry has emerged in the transformation of the development trend.

The average industry TE ranking second is aerospace. The situation of production efficiency of aerospace is similar to heavy industry. Its average SE ranks second in the upper level but average PTE ranks fifth in the downstream level. However after a period of decline, its PTE has begun to increase since 2014, and exceeds the average SE in 2015. This shows that although the industry is a typical investment driven industries and the overall production efficiency is obviously influenced by the scale of economic factors, it has the trend of innovation driven development.

The average industry TE ranking third is electronics industry. The trend of its average TE has a strong volatility that presents "V" with a minimum of 0.721 in 2013 and a maximum of 1 in 2015. Its average PTE ranks second in the upper level but average SE ranks fourth in the lower-middle level. It can be seen that the overall production efficiency of electronic industry is greatly influenced by the production technology and management level. In 2015, the average TE, PTE and SE are all 1, indicating that the overall production efficiency of the industry has reached the optimal level, and all kinds of influencing factors have played a positive role.

The average industry TE ranking fourth is information technology. Its average PTE ranks first that has equal to 1 four years. In the opposite, its average SE only ranks fifth in the downstream level. This reflects that information technology is a typical industry of technological progress, the production technology and management level has a significant impact on the overall production efficiency.

The average industry TE ranking fifth is new materials. The general performance of new material is not so good. Its average PTE ranks third in the middle level, and its average SE ranks sixth that is the lowest in all industries. This reflects that the industry needs to continue to improve the production technology and management level, but also need to enlarge the overall investment, and develop the scale economy effect.

The average industry TE ranking sixth is remote navigation. The overall performance of remote navigation is not ideal. Its average PTE ranks sixth that is the lowest rank, and its average SE ranks third in the middle level. This shows that the industry needs to continue to increase investment and enlarge industrial scale on the one hand. On the other hand, it is urgent to improve the level of management so as to walk into innovation driven development way.

Table 4 Industry TE, PTE and SE (average value)

Ind.	year	TE	PTE	SE	Ind.	year	TE	PTE	SE
Electronics industry	2011	0.91133875	1	0.91133875	Information technology	2011	0.83544225	1	0.83544225
	2012	0.8710055	0.9283695	0.9471995		2012	1	1	1
	2013	0.7213675	0.95360175	0.758415		2013	0.728127	0.94478825	0.787725
	2014	0.94725725	0.94818475	0.99883		2014	0.855133	1	0.855133
	2015	1	1	1		2015	0.8835485	1	0.8835485
Industry average		**0.890194 (3)**	**0.966031 (2)**	**0.923156 (4)**	**Industry average**		**0.860450 (4)**	**0.988958 (1)**	**0.872370 (5)**
Aerospace	2011	0.95587175	0.920569	1.0517425	Remote navigation	2011	0.653150333	0.678866	1.000924
	2012	0.8582005	0.87116875	0.97367675		2012	0.816388333	0.853311333	0.96445367
	2013	0.8193742 5	0.83475175	0.9879875		2013	0.798854667	0.925314333	0.862901
	2014	0.9525715	0.94109	1.01502125		2014	0.872124667	0.862661	1.012214667
	2015	0.92066625	0.9862775	0.93412525		2015	0.862211333	0.870434667	0.989720667
Industry average		**0.901337 (2)**	**0.910771 (5)**	**0.992511 (2)**	**Industry average**		**0.800546 (6)**	**0.838117 (6)**	**0.966043 (3)**
New materials	2011	0.8690825	0.95269975	0.906827	Heavy industry	2011	0.886938333	0.912473	0.9809575
	2012	0.872524	1	0.872524		2012	0.9436685	0.92028	1.039766333
	2013	0.6106475	0.868708	0.6997645		2013	0.869290333	0.891716	0.967992
	2014	0.89664975	1	0.89664975		2014	0.928039	0.8907545	1.059346667
	2015	0.8183365	0.991962	0.8260335		2015	0.974675	0.992250667	0.982094667
Industry average		**0.813448 (5)**	**0.962674 (3)**	**0.840360 (6)**	**Industry average**		**0.920522 (1)**	**0.92149 (4)**	**1.006 (1)**

Note: Because the data in the table is the average, rather than the value of a single enterprise (DMU), so it is only approximate to meet the TE=PTE*SE. The number of brackets for the industry's overall ranking. Ranking are shown in parentheses.

Data resources: Based on the empirical results of MinDS-CRS model and MinDS-VRS model.

4.3 The returns to scale stage

As we can see from Table 5, the enterprises of electronics industry are almost in the stage of constant returns to scale. Although the enterprise 300101 and 002190 have been in the stage of increasing returns to scale over a period of time, they all entered the constant returns to scale in 2015. The enterprise of aerospace are in the stage of constant or increasing returns to scale, where enterprise 000901 and 600316 are in the stage of increasing returns to scale at a long time. The situation of new materials is similar to remote navigation. They are basically in the stage of increasing returns to the scale. The enterprises of information technology are almost in the stage of constant returns to scale. Only enterprise 002253 is in the stage of increasing returns to scale at a long time.

The enterprises of heavy industry are also basically in the stage of constant returns to scale, where enterprise 600590 has been in the stage of increasing returns to scale after the situation of decreasing returns to scale since 2011. However enterprise 300185's situation is relatively complex and has certain volatility, even emerges the situation of decreasing returns to scale in 2015.

Table 5 The returns to scale stage of the enterprises in the industry

Industry	Enterprises (Stock code)	2011	2012	2013	2014	2015
Electronics industry	300101	Increasing	Increasing	Increasing	Constant	Constant
	002339	Constant	Constant	Constant	Constant	Constant
	002190	Increasing	Increasing	Increasing	Increasing	Constant
	002049	Constant	Constant	Constant	Constant	Constant
Aerospace	000901	Constant	Increasing	Increasing	Increasing	Increasing
	600316	Increasing	Increasing	Increasing	Constant	Increasing
	600118	Constant	Constant	Constant	Constant	Constant
	600893	Constant	Constant	Constant	Constant	Constant
New materials	002167	Increasing	Increasing	Increasing	Constant	Constant
	002297	Increasing	Increasing	Increasing	Increasing	Increasing
	601208	Constant	Constant	Increasing	Constant	Increasing
	002428	Constant	Constant	Constant	Constant	Increasing
Remote navigation	600435	Increasing	Decreasing	Increasing	Increasing	Increasing
	002151	Increasing	Increasing	Increasing	Increasing	Increasing
	002230	Constant	Constant	Constant	Constant	Constant
Information technology	002446	Increasing	Constant	Increasing	Increasing	Constant
	002439	Constant	Constant	Constant	Constant	Constant
	002253	Increasing	Constant	Increasing	Increasing	Increasing
	600100	Constant	Constant	Decreasing	Constant	Constant
Heavy industry	002037	Constant	Constant	Constant	Constant	Constant
	600031	Constant	Constant	Constant	Constant	Constant
	600590	Decreasing	Increasing	Increasing	Increasing	Increasing
	300185	Increasing	Decreasing	Increasing	Increasing	Decreasing
	600416	Constant	Constant	Constant	Constant	Constant
	601989	Constant	Constant	Constant	Constant	Constant

4. CONCLUSION

Based on the evaluation of the performance of 25 listed military enterprises, the following conclusions can be drawn.

1. The overall production efficiency of sample enterprises is ideal. Their TE is in a high level and keeps growing momentum as a whole. However, the overall economic benefits of the sample enterprises are declining year by year, and even a large area of loss of business situation happened in individual industries in 2015. This shows that good production efficiency does not bring good economic benefits.

2. The situation of production and management has certain differences in diverse industries. (1) Electronic industry and aerospace are basically in the stage of constant returns to scale. Their TE is in an upper level, and their PTE and SE is balance for comparison. In addition, their GOI and TP are both increasing year by year that is description of the industry is in a golden age of growth and development. (2) Information technology and remote navigation both has the characteristics of better economic efficiency and relatively high production efficiency.

But their overall performance level is not good. They are basically in the stage of constant or increasing returns to scale with a low level of TE. The difference is that the former belongs to the typical technological progress industry with the higher PTE, but the latter basically belongs to the investment driven industry with the higher SE. These two industries' GOI and TP are also in a sustained growth trend, especially the growth rate of TP was high, which reflected a huge potential for development contained in the enterprises in the industries. (3) The production efficiency of heavy industry is good, but the economic efficiency is not ideal, so its overall performance level is low. Heavy industry is in the stage of constant returns to scale, which belongs to the typical investment driven industry, and its TE and the SE of the industry are very high. Besides, the GOI and TP of heavy industry are decreasing year by year. This shows that the industry has encountered some resistance to the development and enterprises in the industry need to upgrade. (4) The production efficiency and economic benefit of the new material are not satisfactory, which leads to the low level of overall performance. The situation of new material is complex. On the one hand, its TE, PTE and SE are not high. On the other hand, its GOI and TP present the obvious volatility. Although it is almost in the stage of increasing returns to scale, the development prospects of the industry is difficult to accurately grasp. Countries and governments need to be supported and guided.

Based on the above conclusions, this paper puts forward some suggestions for the development of sample enterprises.

1. Control the scale and take the technological progress route. The results of this paper show that the size of the input of the sample enterprises is growing, but the GOI and TP are getting lower and lower, the SE trend line (Figure 2) is also in decline. As a result, the sample enterprises have already appeared the situation of diseconomies of scale in general, and have some negative effects on the whole production and operation efficiency. Therefore, it is an important measure to control the scale of investment, to improve the utilization of resources, to improve the management of enterprises and to implement the strategy of innovation driven development.

2. Timely adjust the direction of development. On the basis of the subjective and objective conditions, such as industrial base, industrial structure and policy environment, each industry need to make targeted changes. For the industry of good production efficiency and economic performance, such as electronic industry and aerospace, the recommendation is to maintain their current momentum of development, both taking into account "quality" and "quantity". For the industry of good economic performance but medium production efficiency, such as information technology and remote navigation, the suggestion is that the former appropriately promotes investment, and the latter need to improve innovation capacity on the basis of continuing to expand the scale of production. For the industry like heavy industry of good production efficiency and bad economic performance, the recommendation is to appropriate control scale, improve resource utilization, and accelerate the transformation and upgrading of the industry so as to break the bottleneck of the development of the industry. For the industry like new material of bad production efficiency and economic performance, it needs the support and guidance of the country and the government.

At the same time, the enterprises in the industry should improve the production technology, improve the level of management and broaden the market through their own efforts.

3. Facing the market and promoting the reform of military enterprise shareholding system. *Guiding Opinions* has indicated that promoting the joint-stock reform of military enterprises is a profound change in the field of national defense science and technology industry. It is conducive to break the industry, military and civilian and military enterprise ownership boundaries, broaden the financing channels, as well as establish a standardized corporate governance structure for military enterprises, transform the management mechanism and strengthen the internal vitality and the ability of independent development of military enterprises. It is an effective measure to solve the deep-seated contradictions and problems in the reform and development of military enterprises. However, due to the development of military enterprises greatly affected by the policy, such as in 2013(the *Guiding Opinions* issued), the overall productivity of the sample companies has declined significantly (Figure 2), the majority of military enterprises groups have chosen to take a cautious attitude to the military assets of joint-stock reform. Therefore, the enterprises must emancipate the mind and fully understand the importance and urgency of deepening reform of military enterprises. Only in this way can the military enterprises have a rational view of the "throes" of the reform process, face and adapt to the capital market through shareholding system reform and become a real market subject.

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ACCURACY OF NAVIGATION COMPLEXES

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Abstract: *Airplane flight separation is defined for aircraft equipped with complex navigation systems built on the basis of complexation of navigation information derived from inertial navigation system, doppler speed meter and air signal system.*

Keywords: *RNAV, RNP, accuracy of navigation complexes, separation.*

1. INTRODUCTION

In the context of the Single European sky, it is necessary to define the capabilities of navigational complexes of RNPs (required navigation performances) that allow the flight to be performed under RNAV - Area Navigation (a method that allows navigation of an aircraft flight route within or special navigation equipment (terrestrial or satellite) serving as points of reference, or within the capabilities of autonomous airborne devices or a combination of both methods).

The problem with the deployment of zone navigation consists not only in providing a flight on any route but in that the accuracy of the route maintenance corresponds to the requirements established for the area. These requirements are called Required Navigation Performance (RNP). As a result, zonal navigation issues are closely intertwined with RNP problems. RNP is now considered as a tool for technical and law regulation of RNAV flight operations.

Depending on the requirements for the accuracy of maintaining the set route and the functional requirements for the on-board equipment, the following RNAV names are used:

- B-RNAV (Basic RNAV) RNP5 - Basic Area Navigation;
- P-RNAV (Precision RNAV) RNP-1 - accurate Area navigation;
- RNP - RNAV - Area navigation with necessary navigation features.

2. ACCURACY REQUIREMENTS FOR NAVIGATION COMPONENTS FLEETED WITH BASIC AREA NAVIGATION (B-RNAV) CONDITIONS

RNAV certified airplane is navigation equipment ensuring that the pre-determined flight line maintenance is equal to or better than 5 NM for 95% of flight time (RNP 5). This value includes the source signal error, the onboard receiver error, the system display error, and the technical flight error. The system shall ensure that the probability of loss of all navigational information or the presentation of misleading navigational information is less than $1x10^{-5}$ per hour of flight.

The minimum level of sufficiency and integrity required for RNAV systems for their use in the relevant airspace may be provided by a single on-board system including one or more sensors, a RNAV computer, a control and display unit and a navigation display, provided that system is continuously controlled by the crew and in the event of a system failure, the aircraft maintains its ability to navigate over terrestrial navigation facilities such as VOR, DME and NDB.

When performing operations on the same road line, the minimum RNAV longitudinal separation is 150 km (80 NM).

For airplanes in a horizontal flight, set or downhill on roadway lines, a minimum separation distance of 93 km (50 NM) is used with the required navigational characteristics RNP 10.

3. CRITERIA FOR THE ACCURACY OF THE NAVIGATION COMPLEX IN LONGITUDINALLY ELEVATION

One of the main tasks solved by the navigation complexes is to maintain a set distance or a temporary interval between planes flying one route at the same altitude.

In the first way, it is necessary to pass through a specified route point, at a set time, with a fault of no more than ± b.

In the second, the passage through a certain route point located at a distance S from the exit point must be time-lag error ±τ.

The accuracy in longitudinal direction when defining a boundary by distance is expressed by the formula:

$$\Phi_s(t) = \Phi^*\left[\frac{b}{\sigma_s(t)}\right] = \sqrt{\frac{2}{\pi}}\int_0^{\frac{b}{\sigma_s(t)}} e^{-\frac{x^2}{2}}\partial x; \quad (1)$$

Longitudinal accuracy when setting a boundary over time is expressed by the formula:

$$\Phi_\tau(t) = \Phi^*\left[\frac{b}{\sigma_\tau(t)}\right] = \sqrt{\frac{2}{\pi}}\int_0^{\frac{\tau}{\sigma_\tau(t)}} e^{-\frac{x^2}{2}}\partial x. \quad (2)$$

where: b - a long distance corridor is set; t - given longitudinal corridor at time; Ds (t) = σ_s^2 (t) - the dispersion of the error of determining the longitudinal coordinate S at time t; Dt (t) = σ_t^2 (t) - dispersion of the time t of the passage of the airplane through point S.

4. CRITERIA FOR THE ACCURACY OF NAVIGATION COMPLEXS IN SIDE ELEVATION

In a side elevation, the navigation task consists of providing fields on the specified route. The quality of solving the task is characterized by the probability that, at a given stretch of the flight path, the aircraft will never leave the boundary of the corridor. This probability can be determined by considering a sufficient number of N aircrafts and assuming that they fly at the same speed on the same route and are equipped with one and the same navigation complexes. All airplanes at the beginning of the route section considered (t =0) are corrected (Fig. 1).

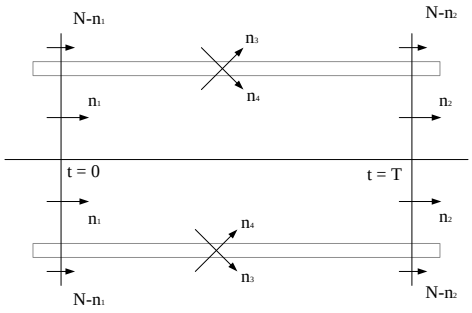

FIG. 1 Schematic of the possible transitions of airplanes at the boundary of the air routes over time (0, T)

Of the total number of airplanes N after the correction, only n_1 planes are found in the corridor, and (n-n_1) are outside. In the process of executing the flight time t. in the range [0, T], from planes in the corridor (n_1) n_3 aircraft will leave the corridor. At the same time, part of the aircraft outside the corridor (n4) will enter it. At the end of the time interval T for the flight of the examined section in the corridor, n_2 of the number of planes and n (n-n_2) of the number of planes are found. Then $n_1 + n_4 = n_3 + n_2$.

The accuracy of navigational flow for aircraft N can be characterized by the number of planes that have never left the boundaries of the set corridor for time t = (0-T). The relative number of these airplanes will be equal to:

$$\frac{n_1}{N} = \left(1 - \frac{n_3}{n_1}\right), \tag{3}$$

and the probability of the aircraft remaining in the set corridor can be used as a criterion for the accuracy of the navigation complex:

$$P = P_1 - P_3, \tag{4}$$

where: P1 is the probability of aircraft entering the prescribed corridor after the correction is made, and P3 is the probability of aircraft departing beyond the boundary of the corridor during the flight for the set interval of time T.

These probabilities can be expressed by the number of aircraft in the groups considered above:

$$P_1 = \frac{n_1}{N} \quad \text{и} \quad P_3 = \frac{n_3}{N}. \tag{5}$$

For the determination of probability P_3, the theory of rebounds of a random process over a certain level is used. Over time the flight changes some navigation parameters (V, W, UO, H, etc.) under the influence of occasional external and internal factors, resulting in deviation of the aircraft from the set route. The navigation process is random and represents a continuous function of time, therefore it is a differentiable process. The main features of this process are:

- the number of crossings at a fixed level from the bottom up, when the derivative of the function is positive;
- the time when the intersection of the fixed level first occurs;
- the length of the time interval in which the function has a value above the fixed level (when the airplane is outside the air corridor);
- the length of the time interval between the individual jumps of the function;
- the value of the maximum exceedance of the fixed function level (linear side deviation LSD $_{max}$).

These features allow you to evaluate the accuracy and reliability of navigational tasks. For air navigation, it is particularly important to determine the probability that for a certain period of time there will be no rebound of the random process.

This probability is unambiguously related to the P_3 probability of the aircraft leaving the boundaries of a given air corridor. From the point of view of random cascade theory, the probability P_3 represents the average number of bounces of the random function of the T time interval.

The formulated criterion meets the basic requirements to the performance criteria of most systems, the most important of which is the ability to obtain a quantitative efficacy assessment.

The accuracy criterion also satisfies other requirements to the performance criteria.

It is inherent in it: efficiency in a statistical sense, low dispersion and hence high accuracy, completeness of the assessment of punctual efficiency, simplicity and presence of physical meaning.

In order to derive equivalences for punctual efficiency, it is necessary to consider a sufficiently large flow of airplanes along the same road line at the same speed and equipped with the same navigation complexes. For this purpose, it is necessary to consider two sections A (t_1) and B (t_2) of the set section of the road line. (Fig. 2).

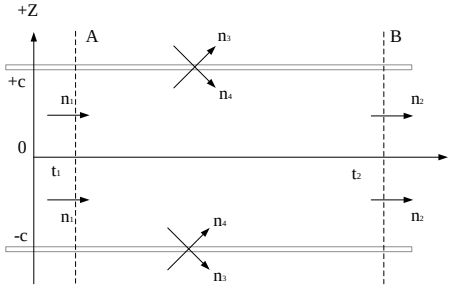

FIG. 2 Schematic of the possible transitions of airplanes at the boundary of the air routes for time $\Delta t = t_2-t_1$

At point O, all airplanes have completed their correction, and their accuracy in determining aircraft coordinates can be described at the time of intersection of section A (t_1) with the two-dimensional probability distribution density ω (Z, Ż / t), and section B (t_2) with the probability probability density ω (Z, Ż / t + Δt) where Z and Ż are the linear lateral deviation (LOD) and the rate of change of the LSD, and $\Delta t = t_2-t_1$ is the time difference between the intersection times of the two sections A and B.

Probabilities P and P3 can be determined by one-dimensional and two-dimensional probability densities ω (Z / t) and ω (Z, Ż / t):

$$P_3 = P_3^+ + P_3^- \tag{6}$$

where:

$$P_3^+ = \int_0^T \omega\left(\frac{c}{t}\right)dt = \int_0^T dt \int_0^\infty \omega\left(c, \frac{\dot{Z}}{t}\right)\dot{Z}d\dot{Z},$$
$$P_3^- = \int_0^T \omega\left(\frac{-c}{t}\right)dt = -\int_0^T dt \int_{-\infty}^0 \omega\left(-c, \frac{\dot{Z}}{t}\right)\dot{Z}d\dot{Z}.$$

P_3^+ и P_3^- are the probabilities of crossing, respectively, the boundaries of the corridor (-c, + c). these probabilities are the same and therefore $P_3 = 2P_3^+$.

The navigation process is a normal random process and the probability densities used are the ratios:

$$\omega\left(\frac{Z}{t}\right)=\frac{1}{\sigma_z\sqrt{2\pi}}e^{-\frac{(Z-m_z)^2}{2\sigma_z^2}}; \tag{7}$$

$$\omega\left(Z,\frac{\dot{Z}}{t}\right)=\frac{1}{2\pi\sigma_z\sigma_{\dot{z}}\sqrt{1-r^2}}\times\exp\left\{-\frac{1}{2\sqrt{1-r^2}}\left[\frac{(Z-m_z)^2}{\sigma_z}-2r\frac{(Z-m_z)(\dot{Z}-m_{\dot{z}})}{\sigma_z\sigma_{\dot{z}}}+\frac{(\dot{Z}-m_{\dot{z}})}{\sigma_{\dot{z}}^2}\right]\right\} \tag{8}$$

where: $m_{\dot{z}}=m_{\dot{z}}(t)=\frac{dm_z(t)}{dt}$;

$\sigma_z^2=\sigma_z^2(t)=k_z(t_1,t_2,)|t_1=t_2=t;$

$\sigma_{\dot{z}}^2=\sigma_{\dot{z}}^2(t)=k_{\dot{z}}(t_1,t_2)|t_1=t_2=t=\frac{d^2k_z(t_1,t_2)}{dt_1dt_2}|t_1=t_2=t;$

$r=r(t)=\frac{k_{z\dot{z}}(t_1,t_2,)|t_1=t_2=t}{\sigma_z\sigma_{\dot{z}}}=\frac{1}{\sigma_z\sigma_{\dot{z}}}\frac{dk_z(t_1,t_2,)}{dt_2}||t_1=t_2=t;$

σ_z and m_z are the mean quadratic deviation and the mathematical expectation of the rate of change of the linear lateral deviation (LSD) at the moment (t);

$k_{\dot{z}}(t_1,t_2)$ is the correlation function of LSD errors;

$k_{z\dot{z}}(t_1,t_2,)$ is the correlation function of Z and Ż;

r is the intercorrelation function of the Z and Ż at the moment (t).

By replacing the probability density ω (Z / t) from (5) is obtained:

$$P_1=\frac{1}{\sqrt{\pi}}\int_0^{\frac{c}{\sigma_z\sqrt{2}}}e^{-q^2}dq-\frac{1}{\sqrt{\pi}}\int_0^{\frac{c}{\sigma_z\sqrt{2}}}e^{-q^2}dq,$$

Where $q=\frac{Z-m_z}{\sigma_z\sqrt{2}}$ is the new variable.

$$P_1=\frac{1}{2}erf\left(\frac{c}{\sigma_z\sqrt{2}}\right)-\frac{1}{2}erf\left(\frac{c}{\sigma_z\sqrt{2}}\right)=erf\left(\frac{c}{\sigma_z\sqrt{2}}\right) \tag{9}$$

To find the probability P_3^+ it is necessary to replace the probability density of (6) and integrate:

$$\omega\left(\frac{c}{t}\right)=\int_0^{\infty}\omega\left(c,\frac{\dot{Z}}{t}\right)\dot{Z}d\dot{Z}$$

$$I_1=\int_0^{\infty}\frac{1}{2\pi\sigma_z\sigma_{\dot{z}}\sqrt{1-r^2}}exp\left\{-\frac{1}{2(1-r^2)}\left[\frac{(c-m_z)^2}{\sigma_z^2}-\frac{2r(c-m_z)(\dot{Z}-m_{\dot{z}})}{\sigma_z\sigma_{\dot{z}}}+\frac{(\dot{Z}-m_{\dot{z}})}{\sigma_{\dot{z}}^2}\right]\right\}\dot{Z}dZ$$

$$I_1=0+\frac{A}{2p}exp\left[-p\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)^2\right]+\frac{A}{\sqrt{p}}\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)\times\left[\frac{A}{\sqrt{\pi}}\int_0^{\infty}exp(-v^2)\,dv+\int_{-\sqrt{p}\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)}^{\infty}exp(-v^2)dv\right]= \tag{10}$$

$$=\frac{A}{2p}exp\left[-p\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)^2\right]+\frac{A\sqrt{\pi}}{2\sqrt{p}}\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)\times\left\{1-erf\left[-\sqrt{p}\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)\right]\right\}=$$

$$=\frac{A}{2p}exp\left[-p\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)^2\right]+\frac{A\sqrt{\pi}}{2\sqrt{p}}\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)\times\left\{1+erf\left[\sqrt{p}\left(\frac{m_{\dot{z}}}{\sigma_z}+q\right)\right]\right\}$$

After replacing the expressions for p, q and A, there is obtained:

$$\omega\left(\frac{c}{t}\right)=\frac{1}{2\pi}\frac{\sigma_{\dot{z}}}{\sigma_z}e^{-\frac{(c-m_z)^2}{2\sigma_z^2}}\left[\sqrt{1-r^2}exp\left[-\frac{1}{2\sqrt{1-r^2}}\left(\frac{\sigma_{\dot{z}}}{\sigma_z}+\frac{r(c-m_z)}{\sigma_z}\right)^2\right]\right.$$

$$\left.+\sqrt{\frac{\pi}{2}}\left(\frac{\sigma_{\dot{z}}}{\sigma_z}+\frac{r(c-m_z)}{\sigma_z}\right)\left[1+erf\left[\frac{1}{2\sqrt{1-r^2}}\left(\frac{\sigma_{\dot{z}}}{\sigma_z}+\frac{r(c-m_z)}{\sigma_z}\right)\right]\right]\right]$$

$$P_3=2P_3^+=2\int_0^T\omega\left(\frac{c}{t}\right)dt$$

5 RESULTS

The test shall be carried out for the following conditions: W=600 – 900 km/h; S=300 – 2000km. c = 10NM.

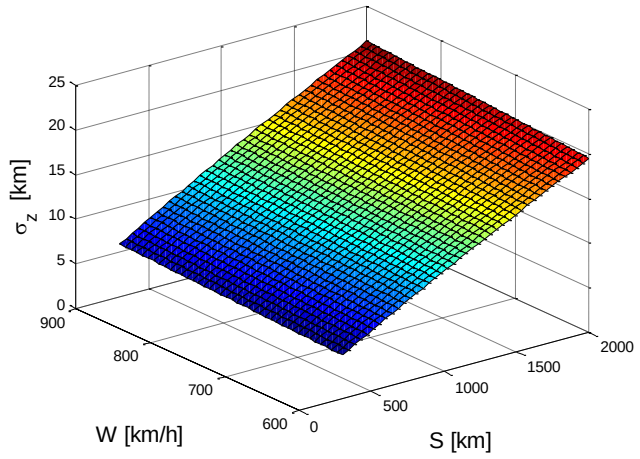

FIG. 3 Dependence of the side deviation σ_z from the speed W and the path S

Table 1

σ_z, km	S=300, km	500	1000	1500	2000
W=600, km/h	4,903	6,800	11,284	15,486	19,505
700	5,236	7,151	11,709	15,998	20,097
800	5,568	7,495	12,112	16,475	20,648
900	5,898	7,835	12,499	16,926	21,165

As the speeds W and S increase, the mean square radial error σ_z increases, varying from 4,903 km to 21,165 km (Tab 1, Fig 3).

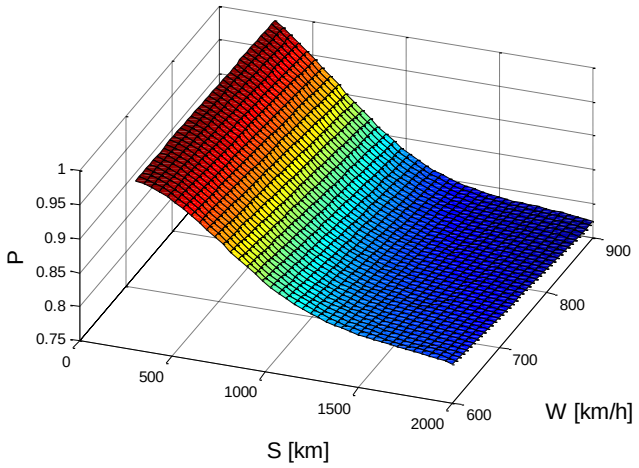

FIG. 4 Probability dependence P for remaining in a corridor ± 5NM from W and S

Table 2

P	S=300, km	500	1000	1500	2000
W=600, km/h	0,9989	0,9792	0,8793	0,8268	0,8071
700	0,9976	0,9700	0,8625	0,8122	0,7944
800	0,9952	0,9595	0,8467	0,7990	0,7833
900	0,9917	0,9479	0,8318	0,7870	0,7733

With the increase of speed W and S, the probability of the aircraft remaining in a corridor with a width of ± 5 NM decreased and varied within the range of 0.9989 to 0.77733 km (Tab 2, Fig 4).

Table 3

σ_s, km	**S=300, km**	**500**	**1000**	**1500**	**2000**
W=600, km/h	12,007	20,005	40,004	60,005	80,005
700	12,007	20,005	40,004	60,004	80,004
800	12,007	20,004	40,003	60,003	80,004
900	12,007	20,004	40,003	60,003	80,003

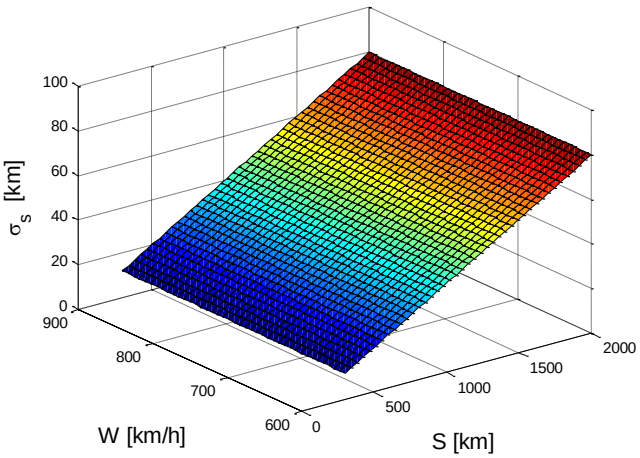

FIG. 4 Dependence of longitudinal deviation σs from speed W and path S

Table 4

$P_{(80)}$	**S=300, km**	**500**	**1000**	**1500**	**2000**
W=600, km/h	1,000	1,000	1,000	0,988	0,939
700	1,000	1,000	1,000	0,988	0,939
800	1,000	1,000	1,000	0,988	0,939
900	1,000	1,000	1,000	0,988	0,939

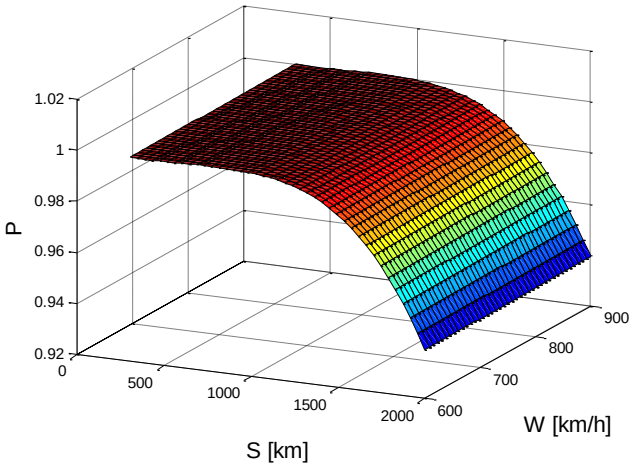

FIG. 5 *Probability dependence P to remain in a corridor ± 80NM from W and S*

Table 5

$P_{(50)}$	S=300, km	500	1000	1500	2000
W=600, km/h	1,000	1,000	0,981	0,883	0,760
700	1,000	1,000	0,981	0,883	0,760
800	1,000	1,000	0,981	0,883	0,760
900	1,000	1,000	0,981	0,883	0,760

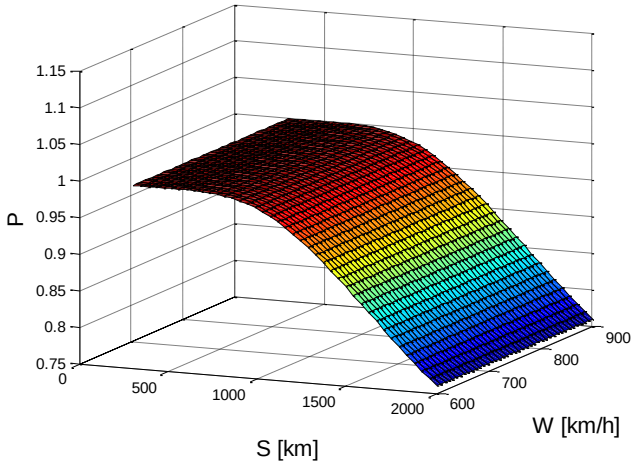

FIG. 6 Probability dependence P to remain in a corridor ± 50NM from W and S

5. CONCLUSIONS

On the basis of the results obtained for aircraft equipped with navigation systems built on the basis of complexation of navigation information derived from Inertial Navigation System, Doppler Speed Meter and Air Signal System, the following conclusions can be drawn:

- Airplanes meet the requirements of B-RNAV for 1000km. route length;
- Airplanes meet the requirements of RNP10 RNAV for 500km. route length;
- Airplanes meet the requirements of B-RNAV (RNP5) up to 500 km. route length;
- for a route longer than 500 km. B-RNAV (RNP5) requirements are not met;
- the aircraft do not meet the requirements of the P-RNAV (RNP1).

For a RNAV flight it is necessary that the aircraft be equipped with navigation systems that complex navigation information from an inertial navigation system, Doppler Speed Meter, Air Signaling System, and Satellite Navigation System.

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INTELLIGENCE PREPARATION OF THE OPERATIONAL AREA

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Abstract: *The purpose of this article, is to offer a brief insight about the intelligence preparation of the operational area, which is the first step to be taken when it comes for starting a military operation. Then it becomes a continuous process that is providing situational awareness for all the command structures, by gathering and analyzing all available information about the options of both friendly and enemy forces, before and during a military operation, in a designated area. In recent conflicts, new threats such as terrorism appeared, which means that the situations evolve faster and in a harder to predict way. As a consequence the newest concepts are using every soldier as a sensor, and all information is being processed and transmitted as much as possible, in real time, thus providing the command structures a real time situational awareness. Given this situation, it is obvious that now more than ever, the intelligence preparation of the operational area is of outmost importance.*

Keywords: *preparation, information, intelligence, awareness, command.*

1. THE CONCEPT OF "INTELLIGENCE PREPARATION OF THE OPERATIONAL AREA"

1.1. General aspects

The intelligence preparation of the operational area, is always the first step that must be taken, before commencing any type of operation in a designated area, being a continuous process that begins before taking any offensive or defensive action and ends after the purpose of the operation has been accomplished. Given the previous description, it is easy to understand, that the intelligence preparation of the operational area is a process trough witch all available information in the operational area, is being continuously gathered and analyzed.

Given the permanent evolution of technology and the fact that the types of threats are permanently becoming more and more diverse, the intelligence preparation is becoming a process of which complexity and speed, keeps on increasing so that today it is possible that the decision making structures can even have real time information from the operational area available. This possibility has in many cases become, a necessary possibility, mostly due to the asymmetric character that most conflicts have today.

As a distinction from classic conflicts, where two or more different countries were taking part in the conflict, using regular troops which were easy to identify and also the operational areas, were easy to identify, the asymmetric conflict is a type of conflict in which the involved parts are no longer only different countries, but also private, criminal or terrorist organizations that are fighting each other or against some countries national armies over ideology or in order to gain large sums of money.

In such cases those involved don't have a uniform and are using tactics such as roadside bombs, ambushes, and assassination, due to the lack of resources necessary for sustained combat.

If in the past, the classical character of the conflict was making the intelligence preparation of the battlefield, a less critical process after the beginning of the operations, having as a main purpose to keep track of the overall situation, which was an easy thing to do, nowadays the hybrid character of the conflicts, is making that the intelligence preparation of the operational area to become a critical process both before starting the operations but also during the operations, because the situations are evolving very fast. As an example of fast evolving situation we can use a simple example. We can presume that one man is entering a checkpoint, wearing no uniform and using a civilian car. This man can prove to be a suicidal terrorist that right after entering the checkpoint is detonating the car he is in, thus creating a critical situation in a place where moments ago, the situation was normal. In such cases, in order for the decision makers to be able to handle the situation, it is necessary that the information would reach them without delay, so that control over the situation could be achieved as fast as possible.

In order to achieve that, the newest concept is using each soldier as a sensor, to rely information in real time. In other words, the attacked personnel would send real time information to the decision makers, which would be able to decide without delay which is the best course of action they should use next, in order to reduce as much as possible, the loss of human lives and the loss of materials.

1.2. Specific theoretical aspects

Each time, in order to do the intelligence preparation of the operational area, there are certain general steps that must be followed, keeping in mind the fact that each one of the steps must be adapted to the specific characteristics of each area and each situation. There are a number of four steps that must be taken. These are defining the operational area, describing the effects that the area could have, threat evaluation, and determining all possible enemy courses of action.

Each step, or function, is being exercised continuously in order to always have the latest information, if possible real time information, so that the decisions could be the best possible in order to properly go from one operation to another, in order to achieve the main goal.

1.2.1 Defining the operational area

This is the first step that must be taken and it has the following points that must be achieved:

- Identifying the specific characteristics of the operational area, such as the land characteristics, local weather, temperature, wet or dry environment, type of transport infrastructure, asphalt roads, communication routes, area demography, local population, the number of civilians, religion, local habits. All of this aspects are influencing the operations of all those involved, friendly and enemy operations, so a thorough analysis is necessary in order to be able to make correct decisions at a later time when they will be needed.
- Establishing limitations for the interest zones, which means that it is necessary to delimitate the geographical areas that are of greatest importance for the command structures.

These first two steps also have the role of pointing the areas where sufficient information does not exist, thus fixing these problems becoming possible, in order to know as much as possible about the situation on the field.

1.2.2. Describing the effects of the operational area

This step is about the opportunities for the both parts, which are available in the area, such as political orientation, local population support or local media attitude. These information might prove useful later on, when the courses of action are going to be developed, in order to achieve maximum efficiency.

1.2.3. Threat evaluation

During this step, enemy forces are being analyzed, in order to determine their possibilities. If the identified threats are already known, then historical facts can be used in order to determine the way the enemy might react.

If the threats are of unknown nature, certain observations must be taken during the operations, so that patterns could be created for later use, in such cases being of very high importance the possibility of providing the command structures with real time information.

Furthermore, the enemy's doctrine must be taken in consideration, in order to elaborate predictions which are as precise as possible.

1.2.4. Determining the enemy's most likely courses of action

Step four, the last one of the steps is using all the information gathered during the previous three steps. After all the information about what is the most probable for the enemy to do, about the capabilities the enemy has, about its interest and about the way the environment might influence its possibilities, has been gathered, the enemy's courses of action can be determined and they can be ordered from the most probable to the least probable course of action. Once this was done, the effort must be concentrated on permanently getting the latest information from the operational area, in order to have some type of a heads up, when it comes for the chances that might occur in the enemy's course of action. The courses of action determined at step four, are only valid if:

- A correct analysis has been made when it comes for a few aspects such as friendly forces priorities and the way that the environment is going to affect both friendly and enemy forces.
- All opportunities both for the enemy and friendly forces, were identified in a correct manner.
- Both the way the enemy acts and the way the area is influencing the operations, has been accounted for.

In short words we can say that all the courses of action can't be accounted for in a correct manner, if the first three steps, were node done in a correct manner.

"*If I always appear prepared, it is because before entering on an undertaking, I have meditated for long and foreseen what may occur.*"[1].

1.3. Different levels when it comes for the intelligence preparation of the operational area

Depending on the size of the interest area, distinction can be made between three levels, the intelligence preparation might have. These levels are the tactical level, the operational level and the strategic level.

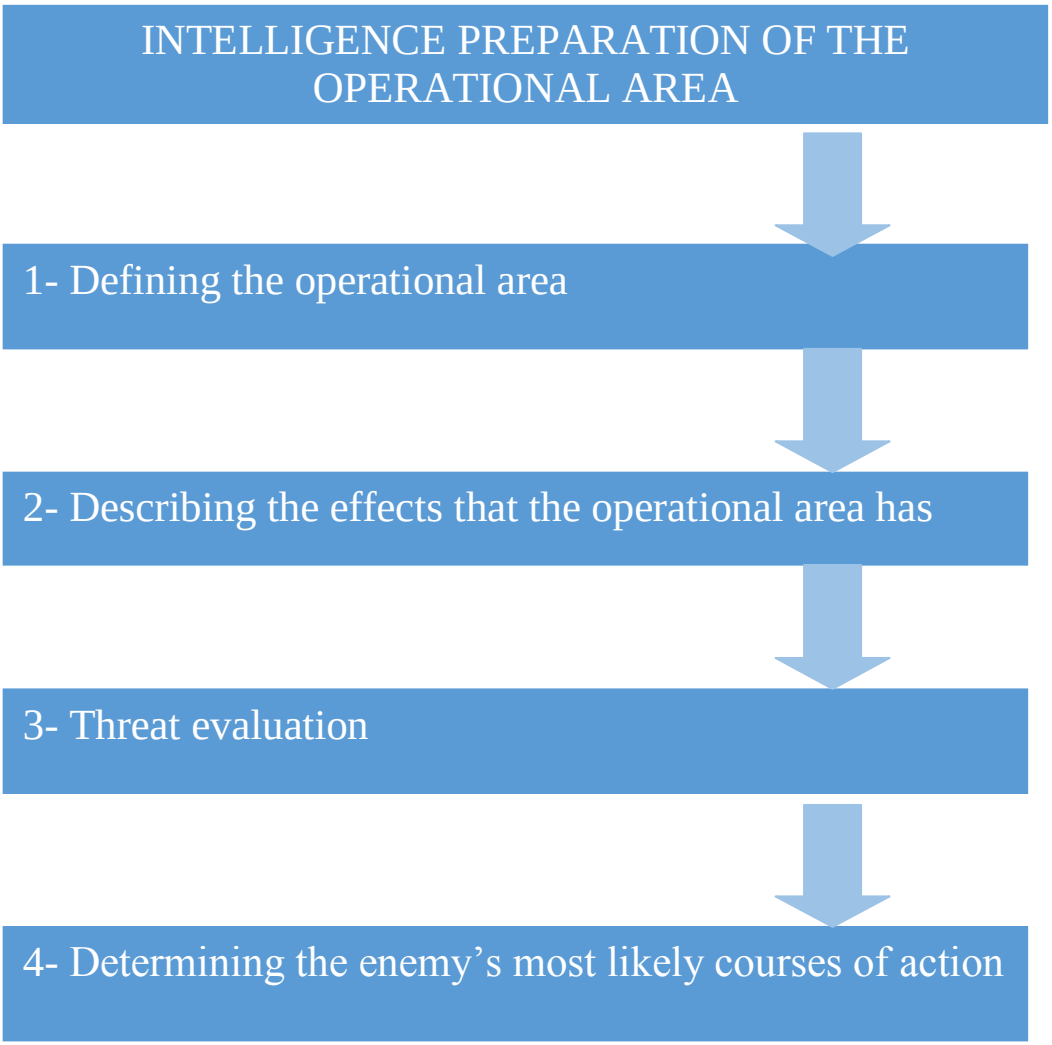

FIG 1: Steps for intelligence preparation of the operational area

1.3.1. Tactical level

This level, in case tactical level units are involved in specific operations, is being limited to the following characteristics:

- The terrain and weather influence over the operations.
- The local transport and communications level.
- The danger generated by specific local disease.
- Enemy forces references, when it comes for their combat effectiveness and efficiency.
- Civilian villages' locations.
- Potential refugees that the operations might have as a side effect and their most likely routes.

- Agreed upon rules of engagement.

In tactical level case the units involved may face limitations such as:

- Local press and propaganda actions.
- Local organizations support or opposition when it comes for the operations.
- Local economy, trading routes.
- Dangerous local criminal organizations.
- Local governments that may be corrupted using various sums of money.

1.3.2. Operational level

In case of this level, additional aspects may be considered, such as:

- Cities where resources or enemy forces might be found.
- Local infrastructure that can be used by the enemy.
- Potential involvement of third organizations that might have some types of interests in the operational area.
- The reaction of local population and local organizations.
- Local law systems.

1.3.3. Strategic level

In this case, some extra aspects must be considered, such as:

-World media support.

-The support of own population, when it comes for the operations.

-The enemy's government ability to deal with the situation.

-Both friendly and enemy forces national economy's ability to support operations of such level.

Given these characteristics, we can determine the character that the operation has.

"*Ironically, our tactical successes did not prevent our strategic failure and North Vietnam's tactical failures did not prevent their strategic success…Our failure as military professional to judge the true nature of Vietnam' war had a profound effect. It resulted in confusion throughout the national security establishment over tactics, grand tactics and strategy…*" [2]

2. CONCLUSIONS OVER THE INTELLIGENCE PREPARATION OF THE OPERATIONAL AREA

Given the new types of threats specific to the modern operational areas, the intelligence preparation of the operational area has become of critical importance, both before starting such operations, but also during their development, the purpose being to achieve a high degree of situational awareness, if possible to achieve real time situational awareness in order to be able to make the best possible decisions at all times.

In this context, it is easy to understand the level of complexity this continuous process might reach, and also it's ever growing importance.

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NEAR FUTURE DEVELOPMENTS TO INCREASE THE ROMANIAN AIR DEFENSE POWER

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Abstract: *The last political and strategic developments gave the Romanian Army the mission to secure the NATO's South-Eastern airspace at a level that will assure an adequate cover for the units temporary or permanently deployed in the area of responsibility. The Romanian government together with the allied structures generated some measures to gradually increase the quantity and quality of the air defense means both in the field of the strategic cover and in the self-protection of the forces. The newest acquisition programs as Patriot, VSHORAD/SHORAD and Navy's SAM capabilities added to the existing Long Range / High Altitude ADS with its own close defense and the AD capabilities of the Naval Joint Battle-Groups deployed in the Black Sea will assure the base for the improved AD protection of the critical infrastructures, population and economy and military assets. The work-paper, following the previous contributions of the authors regarding the Romanian AD, comes to out light a vision about an area integrated multi-layer AD system that can reach its full capability around the years 2024 – 2028.*

Keywords: *AD system, missile, threats, integration, AD cover*

1. BASIC CONSIDERATIONS

Like it's shown in previous work-papers [2], [4], today the AD weapons allowed

both the Ground Forces and the Air Force consist of relatively obsolete systems between some can be kept in endowment with up-grade programs attached and others were lost almost all their efficacy into the modern battlefield and cannot support an improvement plan in reasonable economical condition [1].

Concerning the threat, three directions were designed as significant evolution in

the recent period:

- Start of the equipping air forces around the world with the $4+^{th}$ and the 5^{th} generation multirole fighters and preparations for the 6^{th} generation.
- Growth of the target range in battlefield, including a huge dynamics of drones and stand-off weapons.
- Presence to the large scale of the ballistic threat, with different and specific problems.

As general characteristics, all modern targets have better conditions to out-pass the AD measures, being characterized by:

- low signatures in whole spectrum domains (stealth configuration)
- redundant command and control systems
- increased maneuverability
- high rate of survivability

These directions raise in front of an integrated AD system many requirements, one of them strong contradictory, like:

- short reaction time
- high hitting accuracy
- highly efficacy kill mechanism
- enhanced maneuverability
- multiple target engagement capability
- multiple hit-on-target capability
- high speed engagement capability
- low altitude flight path

Generally, such a large requirement range cannot be satisfied by a single AD missile system and an integrated multi-layer disposal of the AD will need [3].

2. APLICATION AIRSPACE

The geographical positioning of our country in the South-Eastern NATO's flank allow us the necessity to cover relatively large spaces, including land, river or sea borders as well as few high altitude corridors where TBM can get in trough their objectives, representing critical infrastructure assets like bridges, depots, energy plants, transport hubs, political centres, i.e.

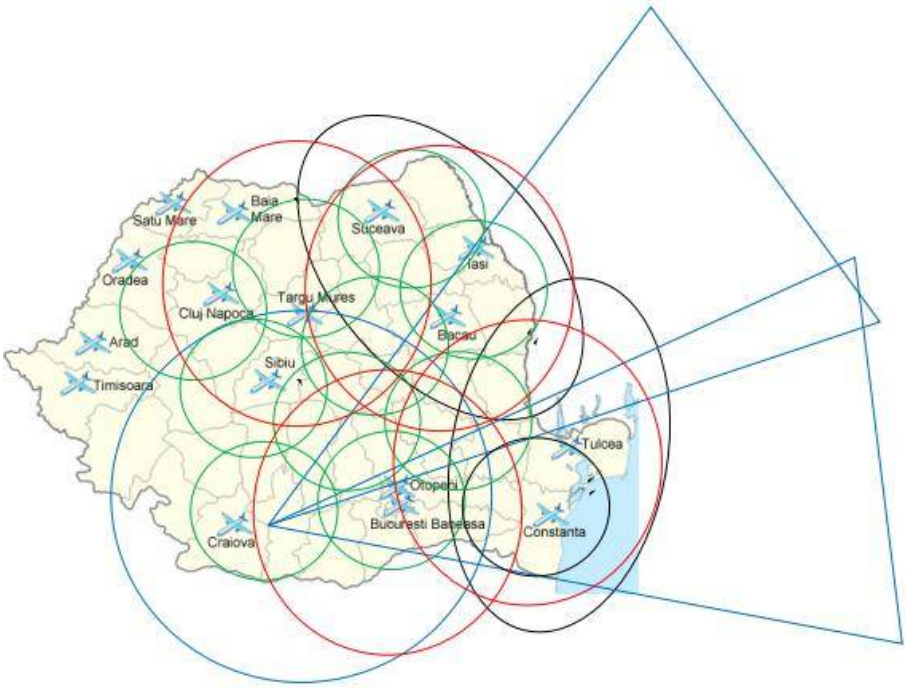

FIG. 1. Multilayer AD coverage variant

In the same time the AD must assure protection for the NATO allied forces using both task force level assigned AD units and tactical units own AD means.

In Eastern side of the Black Sea the AD can be supplemented by the Fleet and allied support ships capabilities for close, medium and sometimes long range.

Using a large part of units in a centric network integrated AD command the sensible non-NATO South-Eastern airspace can be relatively well protected, at an acceptable fire-density level.

To materialise this conception checking the compatibility of the new system acquired with the available sensors and the C3I frame represents a necessity that impose some limits in the models and type of weapons of the different forces categories.

3. TYPE AND QUNTITY OF WEAPONRY

In the next future structure of the Army the AD capabilities will be possible distributed as follows:

Unit / System	VSHORAD	SHORAD	MRADS	LRADS	THAADS
AD Units of GF Brigades	X	X			
AD Units of Divisional Group				X	
AFB Self-Defence Units		X		X	
Fleet AD capabilities	X	X			
Independent Units	X	X			
NATO THAAD			X		X
NATO Expeditionary Warships		X	X		X

The political establishment has began a daring program destined to increase the Romanian AD capability in the next 10-years period.

FIG. 2. Signing the MoU between the representatives of MBDA, ROMARM and SC Electromecanica Ploiesti SA[9]

Regarding the missile systems in discussion was public announced an offer of MBDA for the VSHORAD/SHORAD systems and Raytheon MIM-104 Patriot for LRADMS (HSAM).

MBDA looks for a combination Mistral/VL Mica to satisfy the MoD launched RFI document, offering a pack with technological transfer, integration and maintenance, for an amount of 21 systems in 2 € bill deal.

FIG. 3. The Mistral and VL Mica form the base of VSHORAD/SHORAD proposal

The proposal of Raytheon include 7 batteries at a total cost o 4 € bill.

FIG. 4. MIM-104 Patriot will become the backbone of the Romanian GBAD

The necessary financial effort must cover also the available systems that can be upgraded, small AD weapons, the AD capability of the Fleet (2 frigates and 4 corvettes in short time), continuously improve of the C3I network, maintenance and some support facilities for the strengthening NATO units.

System	QTY	Estimated cost (bill. €)	Comments
VSHORAD/SHORAD	21	2.0	Systems
MRADS up-grade		0.4	
LRADS (HSAM)	7	4.0	batteries
Small AA weapons		0.4	
Fleet AD capabilities	6	0.6	
Enhance C3I capacity		0.2	
Maintenance		0.3	
NATO Units support		0.1	
Total (estimated)		**8.0**	in 10-years program

4. CONCLUSIONS

In the near future significant growths of the Romanian AD capabilities are expected.

Considering the public available information only regarding the AD weaponry assets a significant financial effort will be done for raising this branch of the Romanian armed power, giving to the political establishment an argument as real deterrence factor to deal the opening of a possible conflict.

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CRITICISM AGAINST THE INTELLIGENCE CYCLE

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Abstract: *The cycle of intelligence, as a systematic and permanent process, is meant to reveal the essence, by analysis of data and information, which is subsequently communicated to decision-makers, so that they could make substantiated decisions, of an adaptive action nature, in regard to threats (risks, vulnerabilities) or opportunities.*

Nowadays more than ever, intelligence and even more so, intelligence analysis have become the object of study and discourse, both in civil society and in structures that traditionally deal with this field; intelligence is no longer a prerogative of governments and intelligence organizations, but it became a must for successful strategies carried out by all social players, be it multinational corporations, interest groups, etc., whereas the knowledge paradigm is submitted to azimuth shifts, from the need-to-know orientation, to the need-to-share orientation. In this sense, the practicality of the intelligence cycle as work tool and modus operandi must be revalidated and, if necessary, adapted to the new knowledge environment.

Keywords: *data, information, intelligence, knowledge, wisdom, intelligence cycle*

1. METHODOLOGY OF RESEARCH

This article, starting from the working premise – declaratively stated from the very title of this paper - seeks to discuss the evolution, but particularly the counterarguments and criticism against the actional model currently being used in the intelligence process, both in the theoretical area and in the practical one, implemented in governmental and private organizations.

Any initiative envisaging the launch of a working premise encompassed in a scientific field requires a phase when the research concepts and methods are determined, for which purpose we shall start from the constructivist supposition that the social world can be essentially understood and that the is no unique truth, but several truths more like, and they can be revealed.

In light of this approach, the ontology (which shall provide the answer to the question "what is the nature of reality?") of this study is subjective, characterized by the fact that one's own meanings and perceptions are those filtering reality; starting from the means in which answers can be obtained in regard to the subjects brought up for discussion, the epistemology of research will be interpretative, envisaging not so much to explain the phenomenon being studied, but to understand it in a holistic framework, integrating theories, paradigms, and multiple visions of researchers from this field, to the detriment of critical realism, actional research and positivism.

From this perspective, the methodology is qualitative, the techniques used being those related to the data circulated in the focus-groups targeting the field of intelligence, to the large archives and databases, and subsequently to this initiative, the means of analysis shall insist on inductive tools, i.e. *grounded theory*, thematic and template analysis.

The argumentative content proposed must of course assume a similar interpretative axiology, accepting that it entails the acceptance of a particular set of values (*value-laden*) [2].

2. INTRODUCTION

Intelligence, considered from a polysemous conceptual perspective, even if its relatively recent, exists since ancient times and must be regarded from three perspectives, i.e. knowledge, organization and activity (process and product), as stated by Kent in 1949 – all these being inter-conditional and inter-related since they represent, on a cognitive and syllogistic level, the content, structure and activity, by planning, collecting, processing, analyzing and disseminating a product to a beneficiary, based on which the decision-maker can apply actional measures.

Although this article does not seek to conceptualize the field of intelligence, note should be made that it is mainly regarded from two perspectives, i.e.:

- ✓ traditionalist, starting from the studies carried out by Sherman Kent, clearly defining the fields of intelligence producers and users (beneficiaries); according to this doctrine, the producer's interference in the decision-making process is ill-suited, because it can make it subjective [3];

- ✓ activist, structured according to the theories of Wilmoore Kendall, according to which intelligence must play and assume a dynamic part in influencing the decision-making process [4].

We believe that it is mandatory to briefly clarify the manner in which – so as to obtain the analytic product to be supplied to the decision-maker/beneficiary – the constitutive elements are correlated in terms of the process, i.e. the manner in which, starting from raw data one obtains information which, in their turn, provide the foundation for knowledge, i.e. intelligence, and finally, the refined representation as wisdom.

Practically speaking, in order to be able to reveal said transformation process in the actional melting pot of the intelligence cycle, it was necessary to identify a probable, reliable and viable model allowing the use of reference concepts, and to this effect we propose that the best modus operandi is to use the cognitive hierarchy attributed to Russel Ackoff structuring the content of human cognition by the following concepts: [21]

- ✓ data– represented by symbols, numbers, words;

- ✓ information –data processed so as to be useful and which are filtered by questions such as *who, what, where, when;*

- ✓ *knowledge* – information structured according to a dynamic determinist structure, in reply to the question *how;*

- ✓ intelligence – represented by combining the previously mentioned cognitive levels, i.e. opinions in reply to the question *why;*

- ✓ wisdom – based on intelligence, conviction, combined and assessed databases.

It is interesting to see how specialized literature approaches the intelligence cycle, even if there is the possibility that some readers might deem the migration between the subjects approached as being slightly abrupt: thus, in some researcher's perspective, the cycle is metaphorically perceived as a cyber-system [22] where the core processor "understands" feedback and uses a software to make adjustments.

Intelligence cycle

The origins of the intelligence cycle can be identified in the works of the famous German sociologist Max Weber, the inventor of the concept of "bureaucracy". Starting from Weber's theories we may conclude that any traditional intelligence community is essentially a classical bureaucracy, characterized by a process centralized by planning, routine operations and a hierarchic chain of command.

All these features are present in the traditional intelligence organizations which were not yet submitted to the adaptation to the society of knowledge.

The concept of bureaucracy was one of the key ideas of the 19-century organizational theory. As assembly lines, bureaucracies are efficient because they divide work into controllable units and they facilitate the specialization of individuals by introducing a rigorous division of work. Moreover, they are efficient because they enforce standard operating procedures. When rules are well-defined, everybody knows what they have to do.

In the intelligence community, the bureaucratic model can be found in two key concepts, one of them being the "intelligence cycle". This model includes a few of the characteristics of the intelligence planning process, but it runs over a shorter period of time.

In a minimalist perspective, as a process, the said cycle is meant to reveal an essential value-added product and to communicate it to decision makers, so as to provide the basis for informed decisions with actional-adaptive role in regard to threats, risks, vulnerabilities but also opportunities.

As the approach of the concept of security and its numerous implications, the origin and design of the intelligence process (operative-informative) has military origins; since the time of the Boer Wars, Lord Wolseley provided, in "*Pocket-Book for Army Field Service"* of 1886, detailed instructions on the means of selecting intelligence officers and establishing an intelligence organization. Three phases of the intelligence work were discussed: collection, analysis and reporting.

A systematic description of the implications of producing and using intelligence was developed by the pioneers of military intelligence before World War One, distinguishing between the implications of the collection phase and that of the classification and dissemination of the product to the field units. During World War One, the intelligence of the British Admiralty introduced analysis as a separate collecting and processing function.[17] Subsequently, US Army Regulations published during World War One identified collection, collating and dissemination as essential obligations of the Military Intelligence Division. In 1926, American military intelligence officers recommended four separate functions of tactical intelligence: formulating requirements, collecting, using (processing and analysis) and dissemination, although the "intelligence cycle" was not yet expressly mentioned [23].

The iconic model for the theorization of the aspects related to the intelligence cycle is, of course, the one proposed by Sherman Kent, in his paper "*Strategic Intelligence for American World Policy"*, where he defined intelligence as "knowledge", "organization", and "activity". Kent saw the intelligence cycle as a part of "activity", being the first author having given a clear wording thereof, listing seven separate phases (Kent, 1949):

1. occurrence of a problem requiring the attention of strategic intelligence staff;
2. problem analysis, so as to discover which aspects are relevant to USA security;
3. collecting relevant data pertaining to the problem:
   a. by researching the available data;
   b. by making efforts to procure new data to fill-in the blanks.
4. Critical assessment of the data thus collected, with the intention of finding some "inherent meaning" (a series of premises);
5. Continuing the collection of data in accordance with the most promising premise;
6. Selecting one or more premises with a higher degree of truthfulness as compared to the others – activity often described as the presentation phase.

Some experts believe that the processing function from the cycle's military version was divided by Kent into several separate phases, to underline the significance of intelligence analysis as an autonomous professional function. This practice, to have analysis as a separate function, is still applied nowadays by American intelligence agencies.[17] From a military perspective, NATO's definition of the intelligence cycle is notable, i.e. *a logical thought and action system to ensure the intelligence required by the commander* demanding the chief of staff to implement measures so as to collect information, whereas the latter selects the appropriate source for a specific task in order to eliminate doubles. [3]

In the definition given by the *Central Intelligence Agency*, the intelligence cycle consists in: "*a process whereby primary information is obtained, disseminated, assessed, analyzed and made available as final intelligence products for decision makers, so that they could make the appropriate decisions in substantiating actions*" [31]. The intelligence cycle is triggered by a set of questions and answers (what we need to know, what we currently know, what we need to know from a certain perspective, when we need to know it, the end use of the obtained intelligence product, the costs it entails, and the costs entailed by the absence of said product, etc.), which, in their turn, will generate other questions and implicitly other answers, thus being compared by some researches with a vast neural network.

For the decision makers to be provided with a product encompassing the essence, but also the spirit of certain events, phenomena, processes, situations, state of facts, the mutations appearing in their evolutional structure, etc., a significant part in the intelligence cycle is played by intelligence analysts, those whose role is to know, anticipate and communicate to political and military decision makers the elements of interest in a complete, concise and pertinent manner.

For this purpose, in intelligence activity, there must be a certain "production" management, similar to the one implemented in a high-tech factory/enterprise, whereas analytical activity plays a significant part in the entire endeavor. According to the approach (Anglo-Saxon, French, American) the definition of the process is slightly different, as follows:

✓ According to the French school of thought the cycle consists of four phases: *planning and managing* (determining the need for information, planning and organizing the collection, making requests to this effect to intelligence services), *collecting* (seeking and obtaining information), *using* (complex process of assessing, evaluating, collating, interpreting, analyzing and synthesizing) and dissemination (preparing and transmitting the intelligence product to the clients);[7]

✓ In the American perspective six phases are accepted, as follows: *intelligence* consumers decide and point to the type of information they need, subsequently asking it by formal request, from intelligence experts; the requirements become both reporting and directing agent, whereas the resources to be used by information collectors are assigned in reliance thereon; the collectors obtain the requested information and subsequently they are submitted to a collating, processing, evaluation, and transformation process by analysts; finally, the intelligence product is prepared and presented/disseminated to consumers, who, in their turn, will determine new needs for information, establish new needs for intelligence and introduce the required adaptive measures.[24]

The graphic representation of the intelligence cycle made by the American school of thought and presented in Joint Publication 2-0 (22 October 2013) is illustrative [25]:

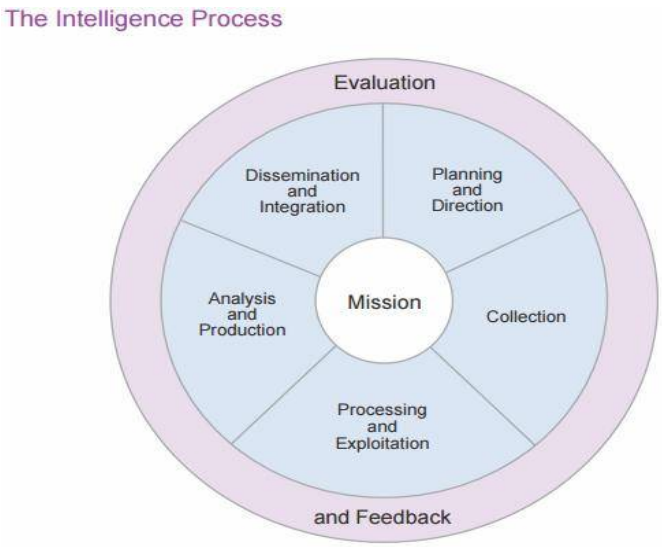

FIG. 1 The Intelligence Process

3. CRITICISM AGAINST THE INTELLIGENCE CYCLE

Today more than ever, intelligence and even more so, intelligence analysis, have become the object of study and discourse, both for the structures that traditionally dealt with the field, and in the private sector, or as suggestively and briefly indicated by Kristian Wheaton, ”*a piece of information is a useful image for a decision maker”*, being applicable in any sector which needs to use such information for its own product. [9]

Bruce Berkowitz and Allan Goodman’s approach of intelligence transformation outlines the need to reexamine the theory and practice of intelligence, in reply to the challenges that the intelligence community deals with:

1. multiplying targets – the intelligence community must analyze a huge volume of information with unprecedented variety;
2. multiplying intelligence consumers not only the amount of intelligence demands has increased, but also the level of preparation and specialization thereof;
3. new challenges in collecting intelligence – collecting intelligence became increasingly difficult, thus increasing the complexity of the raw data transformation process in intelligence;
4. new challenges in intelligence analysis – the complexity of the analytical process by developing the multi-source analysis and using advanced analytical methods;
5. the new intelligence policy – increasing the number of institutional players involved in the intelligence process, changing the attitude towards secrecy and implicitly increasing the amount of available information on the activity of intelligence services;
6. the new role of intelligence – publicly appealing to intelligence in support of internal or external affairs decisions.

Intelligence is no longer the prerogative of governments and intelligence agencies, but it became necessary, as a condition for success strategies carried out by all social parties, be they multinational corporations, nongovernmental organizations, interest groups, etc., whereas the paradigm of knowledge is subject to azimuth shifts, from need-to-know orientation to need-to-share orientation, for which purpose intelligence analysis must be adapted to the new knowledge environment. [9]

If so far we have proceeded to briefly review the definitions of the intelligence cycle, we need to review in the same manner the criticism against the operative-informative process.

In general, it consists in the contrast perceived by theoreticians and practitioners, each in the other's activity.

To this effect, the discrepancy raised by the Church Committee between the theoretical/doctrine areas and the practical one is relevant, in the sense that one of the key aspects of the operative-informative process, i.e. the one related to requirements, reflects merely the manager's acceptance as regards what they think consumers might need, and what the managers think they can provide (through the organizations they are managing) to the beneficiaries.

In other words, the Commission drew attention to the fact that intelligence structures and organizations establish their own priorities in supplying information, and they are not necessarily the object of the political-military decision maker's requests.

As a counterargument, practitioners claim that this situation is caused by a lack of efficient communication between intelligence producers and the beneficiaries of the product and to an unsatisfactory knowledge of intelligence by beneficiaries. Against the background of this hiatus, practitioners are facing the impossibility to clearly define the actional field, and to develop the related doctrine and strategy. In this sense, Michael Herman pointed out that discrepancies may occur from the early stages of the intelligence cycle (the planning phase, the phase when requirements are set forth, to be precise), between intelligence requirements and the manner in which they are applied in practical activity (processual and managerial elements and the bureaucratic nature of intelligence systems). [26]

In French specialized literature, the intelligence cycle (*cycle du renseignement*) is construed differently as compared to the Anglo-Saxon one. According to Par Francis Beau, the intelligence cycle is a process consisting from a series of elementary cycles described by all components of the decision-making/command chain, each acting as a source for the next, and as a client for the previous. [8]

The main role in the intelligence cycle is played by the human factor, and in the most recent analyses performed on intelligence activities in the theatres of operations have demonstrated the limits of the technical models in collecting, processing and analyzing information.

Beau proposes the reconfiguration of the intelligence cycle based on the theory of knowledge and on the mechanism of memory. The new model entails a representation of the memory's functions as a knowledge pyramid varying from the "object" to its representation, organized by 6 main layers (phrasing, positioning, operation, dynamics, qualification, measuring).

The closeness of this field of study epistemology and the theory of knowledge is obvious, but the specificity of the intelligence production process, which is entirely conjectural, entails a much more reactive use thereof, as compared to other fields.

Taking into account the fact that the first true information system used by people was language, a privileged tool meant for giving use to collective memory, allowing for the capitalization, interpretation and dissemination of information, the author crated a theory according to which organizing common memory into a network-like system could be conceived as part of a knowledge preparation model.

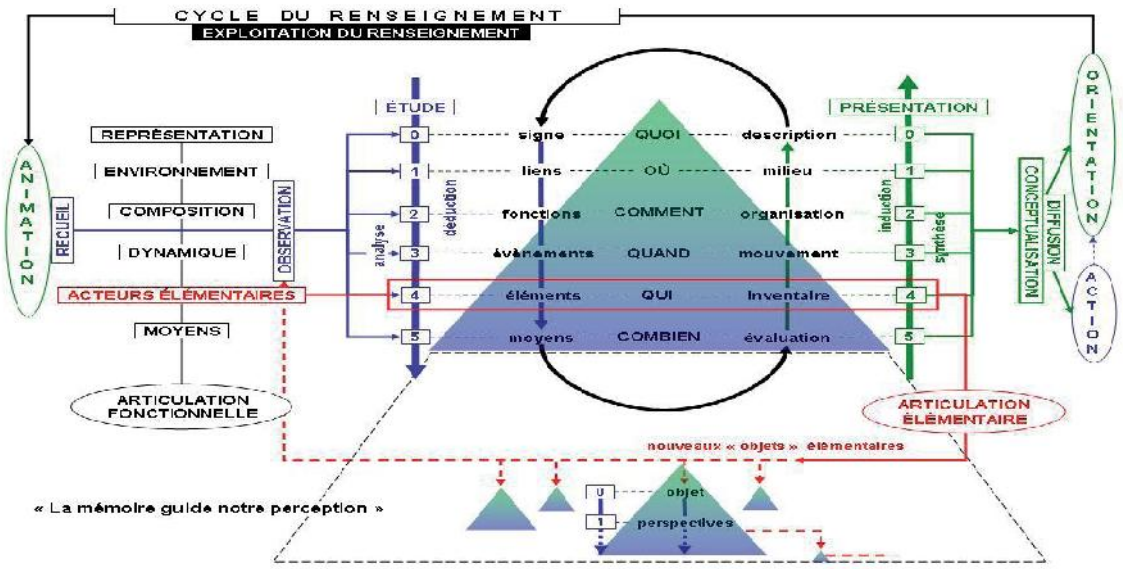

FIG. 2 Intelligence cycle (individual function)

Theoreticians coming from the American school of intelligence draw attention to the fact that in the USE intelligence community there is a lack of consistency (at least at the level of the most representative elements of the national security community), of a common grasp of the intelligence cycle, which also impacts upon the related specific subjects. The chart below is eloquent and illustrative to this effect; according to this chart, of all the phases attributed to the intelligence cycle, only the phase of information collection is common to all 10 analyzed agencies:

	Intelligence.gov (old)	FBI.gov	CIA.gov	WMD.gov	Brown Rudman	DTIC.mil	rdl.train.army.mil	JP 2.0	Classic CI Model	IALEIA.org
Requirements		X								
Needs					X					
Direction						X	X			X
Planning, Direction, Needs, Requirements				X						
Planning and Direction	X	X	X					X	X	
Collection	X	X	X	X	X	X	X	X	X	X
Processing			X	X		X	X			
Evaluation										X
Collation										X
Processing And Exploitation	X	X		X				X		
Analysis				X					X	X
Production										
Analysis and Production	X	X	X		X			X		
Dissemination	X	X	X	X	X	X			X	X
Disseminating and Using							X			
Dissemination and Integration								X		
Feedback					X				X	
Evaluation										
Evaluation and Feedback								X		

FIG. 3 Process-wise comparison between 10 American intelligence agencies [23]

Another argumentative construct entailing the transposition of the intelligence cycle modeling, uses as an explanation the fact that the intelligence cycle modeling is deemed to be, in this context, to be obsolete: by reference to the time when the modeling process was initiated and until the present, numerous mutations of a structural, formal and contextual nature have occurred. [27]

Given that the intelligence cycle was defined more than half a century ago, and in the meantime technology and communications have largely developed, undergoing not only mutations, but actual revolutions, the temporal argument is all the more viable.

In this light, we must consider, as a functional alternative, the cyclic model proposed by Treverton which is more responsively reported to the classical model and involved a constant interrelating of the constitutive parts, although in its turn it is criticized for not paying enough attention to the analytical phase and it does not take into account an extremely important aspect, that of tacit knowledge.[11]

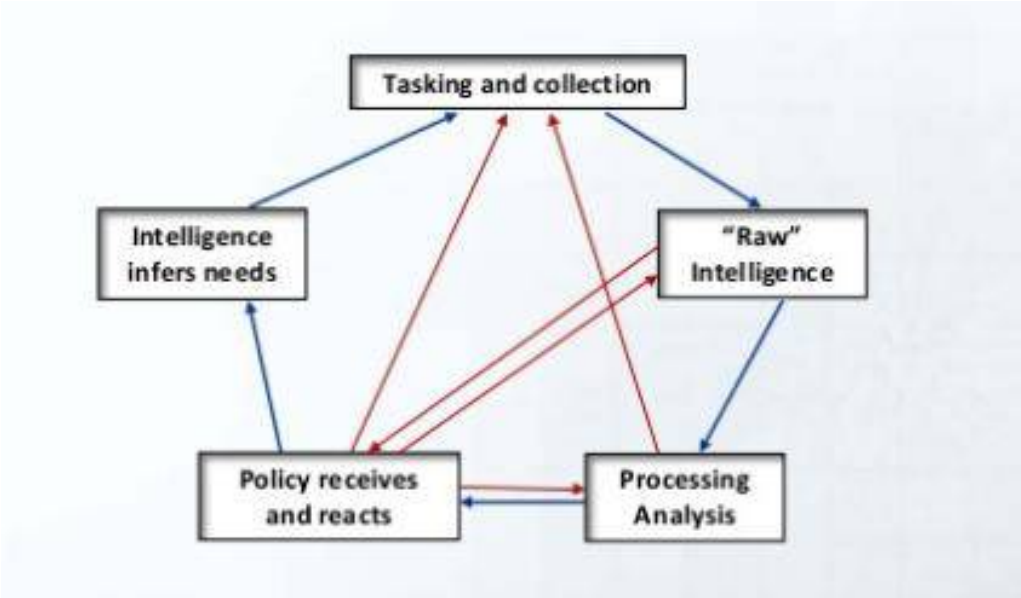

FIG. 4 The "true intelligence cycle*"* (G. Treverton)

Furthermore, from the perspective of the coherence by reference to the temporal aspect, we need to take into account a change related to the applicability of the cycle, as a model, in numerous secondary disciplines (*national security intelligence*, *business intelligence*, *law enforcement intelligence*), which aspects were inexistent at the time when the initial intelligence cycle was designed; in the current context, it would be impossible for the researcher to study and eventually improve the process. By way of consequence, the reforms proposed in regard to an ill-suited and incomplete model will also be insufficient and they will not be able to fix systemic problems.

On the same note, establishing and assigning a budget for such a model will actually suppose additional consumption and effort in finding adaptive ad-hoc solutions; questions will be raised as to the contracting of employees to cover positions which do not comply with the criteria related to the required skills and competences (necessary skills and competences versus acquired skills and competences). In the same line of reasoning, training and instructing students starting from an obsolete or incomplete model is meant to become, from their perspective, an endeavor with no ethical or functional value, which is deeply demotivating and counterproductive.

In their work "*Best Truth - Intelligence in the Information Age"*, Berkowitz and Goodman criticize the traditional model of the intelligence cycle, making an analogy to a production line. [15] Thus, in their opinion, the intelligence process, as it is traditionally designed, is similar to an assembly line. Work specialization and division improve efficiency. Intelligence products go further on the production belt, inserting the collected data and adding the analysis thereof. At the end of the line, there is a quality control inspector who checks the products to make sure they are compliant with the organization standards, and an administrative assistant adds the finishing touches, and the report is ready to be sent.

Although obviously the intelligence cycle models are an idealization of the processes occurring in practice, which are much subtler and more complex. According to Berkowitz and Goodman the problem is not the idealization per se (the manner in which the process would look like if all went according to plan), whereas they believe that even if the traditional intelligence process functioned according to plan, it would still not generate the intelligence that the consumers need.

Robert Clark argued, in 2004, that a restructuring of the image and manner in which intelligence works is necessary, and he claimed that an alternative to the traditional intelligence cycle is that the beneficiaries/interested parties become part of the intelligence process.[20] Clark describes the interested parties of the intelligence community as the intelligence collectors, processing agents and analysts as well as the persons having planned and built the systems supporting these activities.

To include them in the intelligence process, the author claimed that the intelligence cycle needs to be redefined so as to benefit from the evolution of information technology and to be able to handle complex problems.

The author proposed an approached focused on the intelligence analysis target, where the goal is to build a shared image of the target, of which all participants may draw the elements they need, and to which they can contribute with their own resources and knowledge so as to have a clearer image of the target. In this case, we cannot speak of a linear process, but rather a network process, a social process where all participants are focused on the goal.

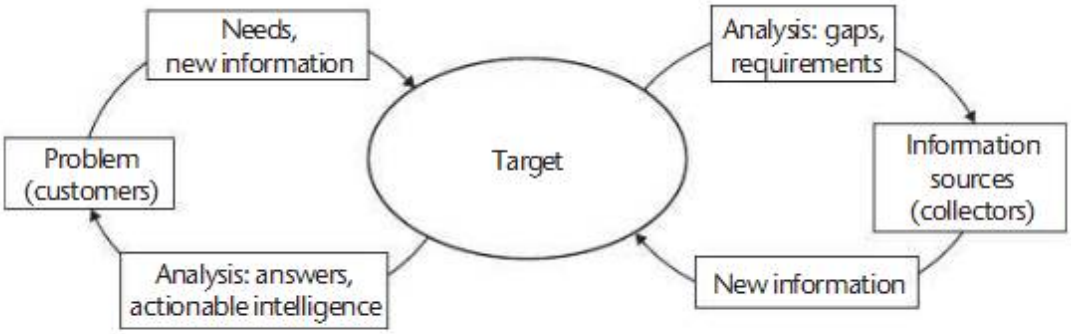

FIG. 5 Intelligence cycle (Source: Clark, 2010:14)

Other approaches blame the lack of unity in the organizational representation of the intelligence cycle: only three out of then such institutions bestow importance on a feedback mechanism as a subset of the dissemination phase, leaving the impression that this major evaluative process must be left at the discretion/choice of the beneficiaries (decision maker).[12]

From another perspective, researchers raise, as regards causality and conditional factors of the intelligence product, the aspects pertaining to creativity and originality; from this perspective, there is an interesting study of Michael Polanyi, who, starting from the ideas of David Hume and John Locke (according to whom knowledge must be experimented, and that it is subjective rather than objective) and promotes the concept of tacit knowledge *(*with five distinctive features: *tacitness* - understandable without requiring explanation; *individuality, situationality, stability, cultural and practicality)*, according to whom we have more knowledge than we express. [13]

We have also identified opinions according to which the intelligence cycle is incomplete and fallible if it does not include in its functional algorithm the counterintelligence aspects [9], just as there are researchers claiming the insufficient representation of the technological impact on the intelligence process, organization and product.[16]

4. CONCLUSIONS

We believe that such discussions and interpretations shall continue to come up, notwithstanding the manner in which the intelligence cycle is accepted or represented at present, for a very simple reason: intelligence producers and requesters are different entities, with different points of view, conceptual definitions and intrinsic knowledge of the intelligence cycle.

We must not lose sight however of the following aspect: no matter the approach of the intelligence process (seen not necessarily as a Holy Grail, but as a skeleton playing an imperative and guiding role, which may undergo upgrades), it seeks to obtain a viable, tested, accurate and precise intelligence product (as a result of a well-defined and properly implemented mechanism for planning, obtaining information, comparing, defining, interpreting, authenticating, analyzing and synthesizing) which must be disseminated to the decision makers objectively, in a pertinent and swift manner, to provide the basis for the necessary decisional adaptive approaches.

The researchers' activity in the field seeks to increase the efficiency of the actional and procedural model, the purpose of such endeavors consisting in adapting the intelligence cycle to the new realities.

An aspect that cannot be neglected is the impact of the new technologies on all the daily or scientific aspects, by introducing tools allowing for the occurrence of new ideas, solving problems, making decisions and implementing the replies thus obtained. [1] Technology is constantly providing us with new tools facilitating for us to obtain quick and qualitative intelligence products, and therefore determining an increase of the situation awareness, respectively of the perception and understanding of the elements constituting the social environment by reference to time, space and causality indices - a *sine qua non* condition of the proper operation of the decision making structures acting in a dynamic, interactive and inter-dependent environment.

In order to be able to redefine the intelligence cycle, we need to understand how it handles *intelligence requirements*, respectively the general or specific topics, in relation to which information needs to be collected, or an intelligence product needs to be generated. [29]

Customarily, the intelligence cycle can be successfully applied to what is called a *standing requirement* which may supply information and substantiate the generation of an intelligence product for medium or long term, but current needs refer to spot requirement, i.e. short-term information and deliverables.

The researchers' efforts as regards the intelligence cycle are designed to optimize the manner in which information is obtained, processed and supplied as a product to decision makers, in an objective and pertinent way, so that in reliance upon same the appropriate decisions are made and implemented.

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BENCHMARKING OF INFORMATION COLLECTIO TECHNIQUES USED IN HUMINT: FROM THE NAZIST INTERACTIVE TECHNIQUES TO THE NATO "GOLD TANDARD"

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Abstract: *Academic studies in the sphere of intelligence and counterintelligence focused predominantly on aspects of the intelligence cycle area, intelligence typology, collecting information from technical sources, axiological aspects (especially those related to the ethics connected to the process of collecting information, recruiting sources), or the feedback received from the decision-makers / beneficiaries of the finite intelligence product, but they have put less emphasis on collecting information from human sources, process and technique that have occupied and continue to occupy a central and determinant role within the domains of reference.*

Although the intelligence field has developed and applied scientific methods, the HUMINT approach as a discipline is found in the context of other socio-human sciences, such as history, psychology, sociology, anthropology, or communication sciences. The concerns in this regard are largely circumscribed to the applied psychology and US intelligence agencies', practices succeeding the Second World War in an attempt to support operational intelligence by delimiting sets of techniques explicitly addressing intelligence from human sources.[1]

Keywords: *intelligence, intelligence cycle, HUMINT, human intelligence gathering, information elicitation*

1. THE OBJECTIVE OF THE RESEARCH

This study revolves the initiative to identify an objective approach, based on scientific evidence and experimentation, to highlight efficiency / lack of efficiency, the opportunity / inopportunity to use dedicated techniques for collecting information from human sources, respectively by HUMINT within the "*information gathering*" phase of the *intelligence cycle*.

We have set up a *benchmarking* in this regard that will be accepted as a *gold standard* in the *HUMINT* field, respectively the "*direct approach*" to which we will cross check three action models (testable, repeatable, evaluable and quantifiable), three techniques for obtaining information based on communication and interrelation which are circumscribed to a meta-method of *elicitation* which has been filtered, refined and perfected in time.

Our initiative is intended to be a starting point, a basis for building a functional structure, a start for future similar researches, circumscribed to both the practical and the theoretical areas of *intelligence*.

2. METHODOLOGY

At an early stage of research we realized the need to address the whole approach from a scientific point of view, in which we made a mapping of the methods to be used to contribute with new elements to the accumulated capital of circumscribed knowledge to the field of *intelligence*; in this context, the epistemology of the research and the way in which we considered that we can reach a valid knowledge sign up within the scope of the interpretative approach according to which the center of gravity is focused on understanding the phenomena studied rather than on explaining them. Essentially, the interpretative paradigm allows us to have multi-faceted access on many levels of reality seen through the perspective of one or more individuals, the context, circumstances, causality and effects of the phenomena under study.

Thereby, the ontology of research and the nature of reality in which knowledge exists (or, in other words, the way we perceive reality, objective or subjective) determined us to operate from a subjective perspective, accepting that reality is built up by individual perceptions and how they interrelate, interdepends and determine the building of collective perceptions. Following this logical thread, the methodology of research - the instruments and techniques used - are circumscribed to the case study that allowed us to explore the phenomenon studied in detail, using multiple sources of information collected over time (providing us with answers to the questions why? how? what? addressed to the investigated subject), as well as comparing and interpreting the obtained results. Consequential techniques and ways of collecting information used in research are specific to the multidisciplinary study from the field of *intelligence* and interviews.

Subtracted to this construct, the data analysis techniques used in the research are inductive, enrolling in an attempt to build an understanding of the relationship between the obtained data sets, so that from them we can identify themes, patterns, acting models, in which the interpretative instruments include thematic analysis and *grounded theory* techniques. From an axiological point of view, we accept that research is of an interpretative nature that brings into question delicate subjects, biased by subjective perceptions and assumes the acceptance of a set of pre-existing values (*value laden*). [2]

3. CONCEPTUAL DISTINCTIONS

Informally called "*the second oldest profession in the world*", the information gathering activity (so that they can be substantiated later on - whether we relate to the individual, social groups, state-owned organizational entities, etc. - decisions of a military, economic, political, and social nature) probably appeared with the first human conflict.

If initially the gathering of information was probably done with instruments circumscribed to the perceptual-sensorial area, and based on these, decisions were made that addressed the basic needs of food, security, and shelter, the intelligence organizations are currently conducting their work in order to obtain products that are essential assets from the perspective of strategic planning, management and marketing decisions, investment, national security, etc.

In light of the above, although not a per se objective, in the context of this research it is necessary to proceed with a brief clarification of the concepts, meaning that the definitions of the intelligence concept are marked by dynamism, polysemy and fluidity, currently lacking a single structure that is generally accepted by both theoreticians and practitioners.

From our point of view, the most appropriate approach is the three-faceted approach, which belongs to Sherman Kent [3] who said that the *intelligence* term refers to the *process* (sum of planning activities, information collection / gathering, filtering / processing, analysis and production, dissemination), the *product* (the deliverable that will substantiate the beneficiaries' action decisions) and the homonym *organization* (the services, organizations, agencies, entities that produce the final product).

In the same way, with an illustrative role, R.V. Jones [4] compares the *intelligence* cycle with the functioning of a human being who, to be able to accommodate and integrate on a social / contextual plan will use all of his receivers to search, get, check information which, once filtered, processed and analyzed, will allow for adaptive decisions to be made.

The present study does not aim at addressing the entire *intelligence* cycle, but, specifically, to the information gathering stage, namely to achieve this goal through *HUMINT*.

This clarification is necessary as the stage itself aims to obtain, from a variety of sources, through a diversity of techniques, means and methods commonly referred to as sources of information (HUMINT, TECHINT, IMINT, PHOTOINT, SIGINT, COMINT, FISINT, TELINT, RADINT, MASINT, OPTINT, ELECTRO-OPTICAL, IRINT, LASINT, NUCINT, RINT, OSINT, MEDINT, CI – *counterintelligence*) of the raw data to be processed and analyzed for the achievement of the *intelligence* product. [5]

4. HUMINT – CONCEPTUAL DISTINCTIONS

The concept, which in fact is an acronym that reduces the phrase of human intelligence to a condensed form, came to life between 1975-1980 and was inserted into the specialized language as "*a form of collecting political or military intelligence through secret agents*" or "*collecting information in a form covered by agents or other sources*" or as "*human intelligence* - military intelligence obtained through human sources who know the target area".[5][7]

As a practice, the activity of collecting information from human sources is mentioned by historiographical sources such as the Art of War (Sun Tzu), Arthasastra (Chanakya), the Old Testament, etc. And, although it has been bearing various names over the millennia, it has preserved the substance, meaning and importance.

Major mutations occurred in the 21st century amid the technological boom (in the field of data processing, communications, etc.) have made the attention of intelligence organizations prioritize other sources of information gathering: Open Source Intelligence - OSINT, Communication Intelligence - COMINT, Electronic Intelligence ELINT etc.

In contrast, there are voices (both among the theorists and practitioners) that pinpoint the recent failures of *intelligence* organizations which is attributed to the lack of information obtained from human sources; in order to support this hypothesis, we use the arguments used by Arthur Hulnick, which stated that human sources "can bring information that cannot be obtained through technical sensors or developed by diplomats; it would be wrong to give up the possibility to find information from within from a well-placed human source. "[6]

In the mentioned argumentative context, we mention that the preoccupations of the theorists working in the *intelligence* area have focused in recent years on elements that predominantly deal with the analysis of intelligence, doctrine, relation with the beneficiaries of the product, on elements of procedural axiology, etc., and, to a lesser extent, on practical issues, which at first sight may seem irrelevant, such as the optimization of information gathering techniques from human sources.

Our desire is to draw attention to these issues and to actively participate in the initiation of a process aimed at rediscovering and optimizing a field of intelligence that seemed to be left unchecked.

The present study continues the pioneering activity in the field initiated by P.A. Granhag, Alison Laurence, S. Oleszkiewicz, H. S. Hodgins, and we want to deepen the following working hypothesis in this regard: *HUMINT's* inefficiency and, as a consequence, failures in *intelligence* are generated predominantly by faulty techniques used in human intelligence.[7],[8],[9]

In this light, we want to make a comparison, a benchmarking, taking as a landmark the *gold standard* in *HUMINT*, a "*direct approach*" and propose an action / complementary approach (taking into account operational models that have proven their effectiveness over time) namely the Scharff technique.

The interest in how information from human sources is gained in the practice of organizations using these sources of information has risen [12], especially after the terrorist attacks on November 9, 2001 in the USA and also the media scandals related to interrogation techniques used in Guantanamo Bay and Iraq. This research initiative also includes the present study, which is intended to be a further step towards the *HUMINT* approach, if not as a scientific field *per se*, at least as a discipline analyzed by means of science.

Direct Approach is defined by the conceptual framework provided by the U.S. Army Field *Manual FM 2-22.3, Human Intelligence Collector Operations*, accredited in 2009 by the US Presidency, through Executive Order 13491 and 13493 (in the revocation of the 13440 Executive Order issued by the Bush Presidential Administration in 2007 which limits the applicability of the Geneva Convention to the detention centers in which the Central Intelligence Agency operates) as a standard in conducting inquiries and obtaining information from human sources.[11]

Chapter 8 of the *Field Manual* details 18 approaches that can be used to collect information from human sources, these being detailed in a motivating, direct, emotional approach and other categories.

According to the presented manual, obtaining information from human sources mainly involves adopting a business-like attitude, the use of direct questions and keeping in touch with the human source as long as it responds in an honest manner.

The Field Manual mentions that the *direct approach* is mainly used to obtain information from human sources and uses statistics from operations in the Second World War, according to which the technique quoted yielded results in approx. 90% of cases and in later conflicts (ex. The *Iraqi Freedom* Operation) the efficiency of the *direct approach* was 95%, but there are no clear delimitations to allow this "efficiency" to be tinted.[14]

The *direct approach* is based on the use of a combination of explicit and open questions, avoiding the guiding questions and, according to US researchers, this technique is currently one of the most common techniques, used in 81% in military interrogations and 45% in civilian ones.[15]

The reason we chose the *direct approach* as a comparison element is precisely its official and formal character, in this case being a gold standard in all similar initiatives.

Although recent years have been marked by an increase in the interest in obtaining information from human sources (mostly in the form of attempts to optimize interview and interrogation methods) there is no significant, consistent empirical research to address this area.[16] [17]

Studies by theoreticians from intelligence schools in the USA focused mainly on the use of emotional approaches, both positive and negative, which they compare (in terms of efficiency and viability) with the direct approach.

According to the cited research, the use of emotional approaches leads to an increase in raw data obtained from human sources, the samples used for this purpose summing up both innocent and "guilty" participants.[18]

It is also noteworthy that US researchers have focused primarily on the judicial or criminological approach and less on the specific framework of HUMINT activities from the point of view of intelligence organizations, and the approach of the two domains, albeit etymologically similar, carries adaptive mutations both in the conceptual sphere and in the action domain: if the HUMINT approach from a criminological perspective only addresses the use of questions aimed at accepting guilt or innocence, from the point of view of intelligence organizations it is necessary to obtain raw data and useful information in order to clarify some aspects related to national security. The difference between the techniques and methods used in the HUMINT applied in the military and intelligence area, and in the judicial / forensic area is notable and has been explicitly dealt with by researchers Randy Borum and Jacqueline R. Evans which state that this is mainly due to policies that guide the work of the two areas.[16] [18]

With regard to *HUMINT* related research in the *intelligence* area, the american school has focused on using the *direct approach* and getting a positive emotional valence, to the detriment of a negative one, the purpose of which is to reduce the anxiety and pressure that are the determinants of obtaining false data and information.[21]

Regarding the ways to optimize the direct approach technique both Field manual 2-22.3 / 2006 and self-study by other researchers, they can be optimized by adopting a positive approach based on interrelation and *rapport* creation, but also using *fear down* techniques (which involves alleviating the source's fears, minimizing them and setting up a climate based on calm and cooperation) and *Pride-and-Ego-Up* (aimed at raising - in the case of human sources - self-esteem and respect for one's own). According to the cited sources, the adoption of these techniques determined to achieve better results than the use of techniques involving the increase of the feeling of fear - *fear up* or the lack of hope - *Pride-and-Ego-Down.*[21] [22] [24]

As far as the *direct approach* technique is concerned, our efforts to identify empirical research demonstrating its validity have proved fruitless, except for the study by Jacqueline R. Evans in 2014 which used a sample of 123 interviewees in an attempt to initiate a first step in the empirical approach to strategies presented in the US Army Field Manual. Conclusively, the *direct approach* augmented with positive emotional adoption has achieved similar results to those achieved by inducing negative emotional states, but had the merit of reducing the anxiety felt by the participants and strengthened their perception of building a relationship with the interviewer, which has facilitated the evocation of data and information.

Having the *gold standard* as a model which was assumed through the US Army Field Manual, the present study proposes a variant, represented by the elicitation techniques that have undergone mild mutations, refinements, which have been translated at the adaptive level in the form of optimizations and efficiencies.

The earliest milestones in the use of these techniques have been signaled since antiquity and are represented by *Socratic maieutic*; subsequent techniques have been adapted and used by a successful Nazi interrogator, Hanns Joachim Scharf which, after the Second World War, put them into practice in the US, basing the eviction techniques currently used by the FBI.

SCHARFF Tehnique

Hanns Joachim Scharff has worked in the Luftwaffe - Auswetestelle West Intelligence and Assessment Center during the Second World War as an interrogator , being considered one of the most efficient interviewers according to D.P. Shoemakerand [25], R.F. Toliver [26] , using a non-invasive, friendly, non-coercive approach based on establishing an interpersonal connection with the target, in this case American and English captured pilots (according to studies by Par Anders Granhag) to remove the suspicions and self-protective measures developed by it, translated factually through the following lines of action according to Toliver's research and the study by Argosy Magazine:

1. I will not discard too many issues during the interview / interrogation;

2. I will try to find out what the interrogator is doing and I will avoid giving him these details;

3. it does not make sense to deny or confirm matters already known by the people who are conducting the interrogation;

His technique involves understanding, assimilating and adopting the perspective and perception of the reality of the person interviewed / interrogated, which gave him the possibility to predict the person's behavior and reactions.

The tactics used by Scharff concerned the following structure:

1. the friendly approach – a good English speaker and connoisseur of the US and UK habits and trends, Scharff frequently began discussions with war prisoners on issues that did not target belligerents;

2. the relaxed approach, avoiding pushing interlocutors to provide information - Scharff used to tell detainees, with multiple details, the elements he knew about themselves or about a particular situation, giving them the opportunity to complete with small details, to confirm or to deny some aspects;

3. the illusion of knowing it all - Scharff initiates the talks stating that there is little chance for the prisoner to know additional elements;

4. using confirmations and denials - Scharff used to say a suite of details about which he knew they had been verified and that they were true, inserting among them elements in relation to which he did not have authentication validation, this being granted by the interviewees.

The techniques for collecting information used by Scharff, analyzed compared to the *direct approach* method, were tested in a suite of empirical research conducted by the team of researchers Par Anders Granhag, Steven M. Kleinman and Simon Oleszkiewicz; the most representative (from our point of view) is the study "*The Scharff Technique: On How to Effectively Elicit Intelligence from Human Sources*" according to which, following the interview of a sample of 60 participants, the use of the Scharff technique significantly and quantitatively determined the obtaining of more information with a precision and novelty, when using the *direct approach*.

The quoted study is, in fact, part of a suite of 9 researches that have repeatedly altered the conditions of research (eg interviewing less cooperative sources, altering questions and using confirmation / denial techniques, repeated interviewing of the same sources, etc.). The most extensive research in this series, „*Eliciting Human Intelligence - A conceptualization and empirical testing of the Scharff technique*", was based on three studies:

- Study I - with a sample of 60 people, was made on the phone and countered the five techniques taken from the instrument of Joachim Scharff through which more information has been obtained, and the participants underestimated the volume and value of the provided information, compared to the direct approach technique that resulted in a lower number of information and interviewees overestimated the value of disseminated information;
- Study II - with a sample of 119 people meeting face to face and participants were allowed to provide erroneous information; the results obtained were similar to those of study I, and, in addition to this, people approached by the Scharff technique have been successful in interviewing non-cooperative human sources, the latter having difficulties in identifying the real goals of HUMINT operators;
- Study III - used a sample of 200 interviewees, the difference being the level of cooperation of sources and the ability to provide information, the research results being similar to those of studies I and II.Meritul inițiativelor anterior menționate este acela că: „*au furnizat un cadru conceptual al tehnicii Scharff prin explicarea aspectelor psihologice ce îi determină funcționarea și aplicabilitatea, au introdus o nouă paradigmă în explicarea eficacității tehnicilor HUMINT, au oferit un nou set de măsurători utilizabile în cartografierea culegerii de informații din surse umane și au demonstrat în mod empiric eficiența abordării interogatorului nazist*" în comparație cu utilizarea tehnicii acceptate ca *gold standard* în materie de colectare a datelor din surse umane – *direct approach.*

5. CONCLUSIONS

Circumscribed *HUMINT*, whether we talk about elicitation techniques or "direct approach", regardless of whether they are circumscribed to government / state or private intelligence, the reality will always be the same: the condition "sine qua non" in obtaining and retaining the advantage - from the perspective of competitiveness and security – consists of information, respectively protecting their own secrets while unleashing and exploiting those held by the competition.

The collection and dissemination of information is based on the human need to engage in relationships, to receive feedback about one's own / activity, to be accepted, to understand others and daily realities, etc.

The mechanisms underlying the presented techniques are generally human and are used both offensive and defensive by elicitors, but also by individuals / entities wishing to protect their valuable information.

In this regard, we consider useful the permanent involvement in personal training in order to know the mechanisms underlying the information gathering activity (by adopting prudent conduct that minimizes the chances of unauthorized and unintended dissemination of information) and, at systemic level, adopting measures / policies / strategies to block or minimize the efforts of informational opponents.

As an example, we present the steps taken by the intelligence services in Germany, England, the Netherland, the USA and not least by Romania which began studies and research related to the field of intelligence, concretely translated into forms of presentation (publications, leaflets) with practical applicability in the area of protection and counter information training.

The motivation of this research is that evolution cannot be seen as a vertical and monotonous initiative, initiated at an Alpha moment and finalized in a vertical visual representation at an Omega moment, but it is marked by hiatuses, jumps, rebounds, breaks of previous patterns and paradigms.

History teaches us that the human race has built up various such theories, research methods, and paradigms over the centuries that have provided a degree of safety and comfort from the point of view of providing an explanation and implicitly an active way of responding to the various unknown cognitive behaviors. But inevitably redistributions, reconfigurations, reconceptions, new research directions are emerging which lead to the resizing of previous paradigms and sometimes to their breaking.

Our intention is not to demonstrate the validity or invalidity of a field-based approach (HUMINT), but rather has a constructive role to add elements that can in turn be a starting point for future research initiatives circumscribed to this workspace.

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RESEARCH ON THE FORMATION AND EVOLUTION MECHANISM OF CHINA'S DEFENSE INDUSTRIAL CLUSTERS

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Abstract: *The evolution of China's defense industrial cluster is essentially a game of military enterprises and civil enterprises. In order to analyze the behavior of military enterprises and civil enterprises in the evolution process of defense industrial cluster, this paper construct an evolutionary model for analyzing the evolution mechanism of China's defense industry cluster based on evolutionary game theory. The results show that, in the development of China's defense industrial cluster, there are two long-run equilibriums: cooperation and non-cooperation. There are four factors have significant influence on the long-term equilibriums: profit of cooperation, distribution of cooperation profit, amount of investment and transaction cost.*

Keywords: *Defense Industry; Industrial cluster; Evolution Mechanism; Evolutionary Game Theory*

1. INTRODUCTION

As a kind of economic phenomenon, industrial cluster has been mentioned in Marshall's theory of external economy (1920) and Webb's theory of industrial location (1929). In the late 1970s, industrial cluster has gradually become a hotspot in management science, economics, sociology and other disciplines. Industrial cluster plays an important role in technology innovation, industrial structure adjustment and the establishment of regional economic agglomeration.

After years of "conversion" practice, China's defense industry has formed a large and medium-sized state-owned military enterprise accumulation area in the Midwest. Civil-military integration industrial park developed rapidly. Defense industrial cluster has entered a new stage of development.

But the current national defense industry agglomeration is formed under the guide of the government, rather than the market mechanism. The advantage of military enterprises in resources and technology has not yet fully played, and the fusion effect of defense industry and regional national economy has not been fully revealed.

Therefore, basing on current situation of China's defense industry, learning from the experience of defense industrial clusters all over the world, analyzing the mechanism of defense industrial cluster evolution and promoting the development of China's defense industrial cluster, have become an important problem urgently need to be studied.

The evolution of China's defense industrial cluster is essentially a game of military enterprises and civil enterprises. In order to analyze the behavior of military enterprises and civil enterprises in the evolution process of defense industrial cluster, this paper construct an evolutionary model for analyzing the evolution mechanism of China's defense industry cluster based on evolutionary game theory.

2. EVOLUTIONARY GAME MODEL AND THE EVOLUTIONARY CHARACTERS IN THE DEVELOPMENT OF DEFENSE INDUSTRIAL CLUSTER

The analysis in micro economic theory is mainly equilibrium analysis. The basic hypotheses are fully competitive market and rational man. In practice, due to the limitation of human cognitive ability, the individuals involved in the game are limited rational. Their decision behavior would be affected by environment, daily practices and other factors. Their strategy equilibrium is not the result of one-time selection, but the realization of learning adjustment. And equilibrium analysis is not applicable to this problem. Therefore, the paper analyzes the selection and evolution path of defense industrial cluster using evolutionary game theory based on "bounded rationality" hypothesis.

2.1 The framework of evolutionary game model

The basic hypothesis of evolutionary game model is "bounded rationality". The framework is based on Darwin's natural selection theory, which is used to research the species trait evolution and stability mechanism. "replication dynamics" in biological evolution of biological character and behavior characteristics is the main dynamic mechanism in the analysis of limited rational game, and "evolutionarily stable strategy" is the core concept.

There are two players in a game, whose names are respectively P1 and P2. Each of them has two strategies: S1 and S2. S1 is a conventional strategy and S2 is an mutational strategy. When the combined strategy of P1 and P2 is (S1, S2), their payoff are U1 (S1, S2) and U2 (S1, S2). Suppose, the probability of P1 and P2 to choose the mutation strategy is α, and the expected payoff of them Using the strategy of S1, S2 respectively are as follows:

$$(1-\alpha)u_i(s_2,s_1)+\alpha u_i(s_2,s_2) \quad (1)$$

$$(1-\alpha)u_i(s_1,s_1)+\alpha u_i(s_1,s_2) \quad (2)$$

If $\overline{\alpha}>0$, than $(1-\alpha)u_i(s_1,s_1)+\alpha u_i(s_1,s_2)=(1-\alpha)u_i(s_2,s_1)+\alpha u_i(s_2,s_2)$, and there are multiple evolutionary stable points in the game, respectively are:

$\alpha^*=0$, $\alpha^*=\overline{a}$ and $\alpha^*=1$. When $\alpha^*<\overline{a}$, the expected payoff of the player who chooses mutational strategy will be less than who chooses conventional strategy.

And the player who chooses mutational strategy will be excluded from the population, the combined strategy (S1, S1) is the equilibrium combination and the conventional strategy will be the evolutionarily stable strategy.

When $\alpha^*>\overline{a}$, the expected payoff of the player who chooses mutational strategy will be larger than who chooses conventional strategy. And the player who chooses conventional strategy will be excluded from the population, the combined strategy (S2, S2) is the equilibrium combination and the mutational strategy will be the evolutionarily stable strategy.

When $\alpha^* = \bar{a}$, the expected payoff of the player who chooses mutational strategy will be equal to who chooses conventional strategy. The ratio of members taking conventional strategy and mutational strategy will be maintained at $\bar{a} : (1-\bar{a})$.

But the ratio is not stable. Once the random factors increased the number of player choosing a certain strategy, the evolution of the group will be conducive to the team who choose this strategy, until a new equilibrium.

The basic framework of evolutionary game model shows three notable features in the process of analysis: the first, the decision behavior of individuals involved in the game would be affected not only by individual rationality, but also by environment, daily practices and other factors. They are "bounded rationality". Second, there are three important mechanisms in the process of evolution, which include mutation mechanism, selection mechanism and diffusion mechanism. That is why path dependence exists. Third, the results of evolution have multiple equilibriums, and there are several evolutionary stable points.

2.2 The evolutionary characters in the development of defense industrial cluster

Many economists believe that the industrial cluster is a phenomenon related to the concentration of industrial activities in geography or in a particular place. Defense industrial clusters is, in the field of defense, breaking the barriers between military enterprises and civilian enterprises, the agglomeration of a number of defense industry and related enterprises in a particular space. Interaction of economic agents in defense industrial cluster, mainly be seen as the game of military enterprises and civilian enterprises. And evolutionary game is a remarkable character in the course.

2.2.1 *The economic agents in defense industrial clusters are "Bounded Rational People"*

In the process of forming and evolution of the defense industry cluster, only when the expected return of cooperative behavior is higher than those in non-cooperative condition, the economic agents will choose cooperation. But the interaction between the agents in the process is complex.

The economic agents should not only consider the choice of each player's strategies when they involve in the game, but also the changes of strategies when new members engage in. In this process, many deterministic and stochastic factors in the environment may have a significant influence on individual strategies. It's not the results of one-time choice, but an effect of adaptive adjustment. Therefore, the interaction between economic agents in the formation and evolution of defense industrial cluster can be regarded as the game between "bounded rational people".

2.2.2 Path dependence exists in the formation and evolution of defense industrial cluster.

There are three major mechanisms in evolutionary game theory: the selection mechanism, mutation mechanism and diffusion mechanism. Defense industrial cluster can also be seen as the results of continues evolution of defense industry under the effects of the three mechanisms. Under the action of selection mechanism, individuals of low profits will be eliminated, and individuals of high returns will be able to survive.

Under the action of mutation mechanism, individuals seek new resources through various channels to achieve rapid development. New combination forms of military and civilian resources appear continuously, thus leading to new defense industrial clusters. Diffusion mechanism is mainly included in the following: external individuals engage in industrial cluster and survive through the selection mechanism. Other individuals will choose a similar way. This way of cluster will be gradually developed and evolved into the norm of economic system. Under the action of three mechanisms above, path dependence exists in the evolution of defense industrial cluster.

This means that the formation and evolution of defense industrial cluster depends largely on the initial state of defense industry. Initial state, the more conducive to the individuals engaging in industrial clusters, the more individuals will participate, the clustering will develop faster.

Path dependence is a double-edged sword. In certain condition, it can provide technical knowledge and system guarantee to reduce the uncertainty and support the formation and evolution of defense industrial cluster. But it also may become the obstacles and bottlenecks of restricting the development of cluster.

2.2.3 The result of defense industrial cluster evolution have multiple equilibrium

Due to the path dependence in defense industrial cluster formation and evolution, the initial state of system will have significant influence on the result. Nuances in initial state could make the defense industrial cluster on a different evolution path, thus appeared completely different evolution results. That means the defense industrial cluster evolution will eventually tend to a steady state, however, the steady state is not the only one, but multiple. In fact, in addition to individuals' preference and the influence of the initial conditions, the equilibrium results of game and the degree of defense industrial cluster development are also affected by also by macro policy and a set of external random factors. Under certain conditions, the behavior pattern of individual in evolution will tend to cooperation, cooperative equilibrium may be achieved so that further development of defense industrial cluster is insured.

When external conditions change, under the influence of path dependence, the behavior of individuals may subsequently change. In this case, a non-cooperative equilibrium results may appear.

Therefore, the main features of evolution of defense industrial cluster are consistent with the basic characteristics in evolutionary game theory. The framework of evolutionary game model can be used to construct a macro model with micro foundation. This model can be used to analyze behavior decision of "bounded rational people".

3. AN ANALYSIS OF THE FORMING AND DEVELOPING MECHANISMS FOR DEFENSE INDUSTRIAL CLUSTERS BASED ON EVOLUTIONARY GAME MODEL

The forming and developing of defense industrial clusters can be as the results of dynamic game between stakeholders such as military enterprises and civil enterprises. In this process "bounded rational" economic agents are affected by complexity and diversity in the game. Their decision-making process is a dynamic process of learning and strategy adjustment.

3.1 Basic assumption

To highlight the evolutionary characters and weaken insignificant factors, this research is based on the hypothesis as follows:

1）There are two types of economic agents, respectively is military enterprises and civil enterprises. Both of them are Individuals with bounded rationality. Their strategy sets are (cooperation, non-cooperation).

(2) Individual selects cooperative strategy will pay a certain amount of transaction costs for acquiring information and communicate with each other to facilitate collaboration. The transaction cost of military enterprise is c1. And the transaction cost of civil enterprise is c2.

(3) If both military and civil enterprises select cooperative strategies, then reaches cooperation.

The amount of capital invested in cooperative program by military enterprise is v1, and which made by civil enterprise is v2. a is the extra yield generated by cooperative program in defense industrial cluster. b is proportion of extra yield which civil enterprise obtained from cooperation, and 1-b is the proportion which made by military enterprise.

(4) If military and civilian enterprises both choose non-cooperative strategy, both of them can only get the normal returns, respectively are π_1, π_2.

(5）In the initial stage of the game, the proportion of military enterprises using cooperative strategies is $p\ (0 \le p \le 1)$, while the proportion of which using non-cooperative strategies is $1-p$. The proportion of civil enterprises using cooperative strategies is $q\ (0 \le q \le 1)$, and the proportion of which using non-cooperative strategies is $1-q$.

3.2 A dynamic evolutionary model on defense industrial cluster

Hypothesis 3 and Hypothesis 4 shows that the income of military and civilian enterprises can be divided into two parts: normal income obtained from independent operation and the additional revenue obtained from cooperative program. If military and civilian enterprises both choose non-cooperative strategy, both of them can only get the normal returns, respectively are π_1, π_2.If both of them choose cooperative strategies, the benefit of military enterprise is $\pi_1 - v_1 - c_1 + abV$ and benefit of civil enterprise is $\pi_2 - v_2 - c_2 + (1-b)aV$. If the military enterprise chooses cooperative strategy, while civilian enterprise chooses non-cooperative strategy, the benefit of military enterprise is $\pi_1 - c_1$ and benefit of civil enterprise is π_2. If civilian enterprise chooses cooperative strategy, while military enterprise chooses non-cooperative strategy, the benefit of military enterprise is π_1 and benefit of civil enterprise is $\pi_2 - c_2$.

Therefore, the expected return of military enterprises choosing cooperative strategy is

$$U_1^1 : U_1^1 = q(\pi_1 - v_1 - c_1 + abV) + (1-q)(\pi_1 - c_1) = \pi_1 - c_1 - qv_1 + abqV \quad (3)$$

The expected return of military enterprises choosing non-cooperative strategy is U_1^2:

$$U_1^2 = q(\pi_1) + (1-q)(\pi_1) = \pi_1 \quad (4)$$

In this case, the total expected profit of military enterprise is U_1:

$$U_1 = pU_1^1 + (1-p)U_1^2 = \pi_1 - pc_1 - pqv_1 + abqpV \quad (5)$$

The expected return of civil enterprises choosing cooperative strategy is U_2^1:

$$U_2^1 = p[\pi_2 - v_2 - c_2 + a(1-b)V] + (1-p)(\pi_2 - c_2) = \pi_2 - c_2 - pv_2 + apV - abpV \quad (6)$$

The expected return of civil enterprises choosing non-cooperative strategy is U_2^2:

$$U_2^2 = p(\pi_2) + (1-p)(\pi_2) = \pi_2 \quad (7)$$

In this case, the total expected profit of military enterprise is U_2:

$$U_2 = qU_2^1 + (1-q)U_2^2 = \pi_2 - qc_2 - qpv_2 + apqV - abpqV \quad (8)$$

Accordingly, we can get the replicated dynamic equations of military enterprise and civil enterprise respectively.

$$\frac{dp}{dt} = p(U_1^1 - U_1) = p(1-p)(abqV - c_1 - qv_1) \quad (9)$$

$$\frac{dq}{dt} = q(U_2^1 - U_2) = q(1-q)(apV - abpV - c_2 - pv_2] \quad (10)$$

Equation 9 is the replicated dynamic equation of military enterprise, which shows that: If the benefit of military enterprise which chooses cooperative strategy is larger than the average, the number of cooperative military enterprises will increase. If the benefit of military enterprise which chooses cooperative strategy is less than the average, the number of cooperative military enterprises will drop. Equation 10 is the replicated dynamic equation of civil enterprise, which shows similar information.

3.3 Analysis of the equilibrium results of the model

The replicated dynamic equations of military enterprises and civil enterprises reflect the dynamic process of the formation and evolution of the defense industry cluster. If we set $\frac{dp}{dt} = 0$, the roots of this equation are p=0; p=1 and $q = \frac{c_1}{abV - v_1}$. If we set $\frac{dq}{dt} = 0$, the roots of this equation are q=0; q=1 and $p = \frac{c_2}{(1-b)aV - v_2}$. Accordingly, we can get 5 equilibrium points in the game of defense industry cluster, which are O= (0，0); A= (0，1); B = (1，0); C= (1，1) and D=（$\frac{c_2}{(1-b)aV - v_2}$，$\frac{c_1}{abV - v_1}$）.

As for the civil enterprises, when $p=\frac{c_2}{(1-b)aV-v_2}$, there will always be $\frac{dq}{dt}=0$. When $p>\frac{c_2}{(1-b)aV-v_2}$, there will be $\frac{dq}{dt}=0$ only when q=0 or q=1. Before reaching an equilibrium point, there will be $\frac{dq}{dt}>0$, thus q=1 is the evolutionarily stable strategy. When $p<\frac{c_2}{(1-b)aV-v_2}$, there will be $\frac{dq}{dt}=0$ only when q=0 or q=1. Before reaching an equilibrium point, there will be $\frac{dq}{dt}<0$, so q=0 is the evolutionarily stable strategy.

Correspondingly, for military enterprises, when $q=\frac{c_1}{abV-v_1}$, there will always be $\frac{dp}{dt}=0$. When $q>\frac{c_1}{abV-v_1}$, there will be $\frac{dp}{dt}=0$ only when p=0 or p=1.

Before reaching an equilibrium point, there will be $\frac{dp}{dt}>0$, thus p=1 is the evolutionarily stable strategy. When $q<\frac{c_1}{abV-v_1}$, there will be $\frac{dp}{dt}=0$ only when p=0 or p=1. Before reaching an equilibrium point, there will be $\frac{dp}{dt}<0$, so p=0 is the evolutionarily stable strategy.

The dynamic evolution of defense industrial clusters the defense can be represented in figure 1, and there are $p^*=\frac{c_2}{(1-b)aV-v_2}$ as well as $q^*=\frac{c_1}{abV-v_1}$.

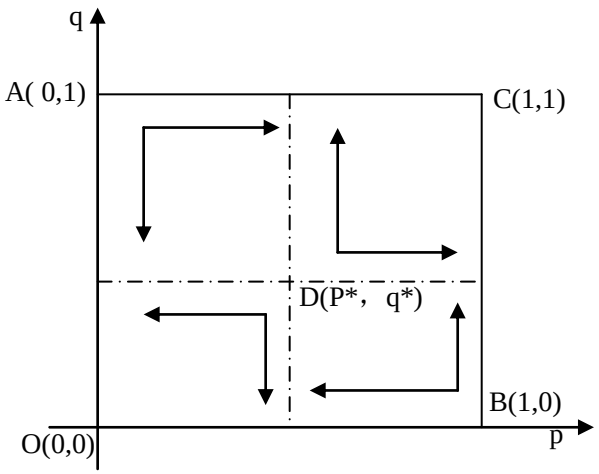

FIG 1. Dynamic evolutional model of defense industrial cluster

As can be seen from Figure 1, (1, 1) and (0, 0) are possible evolutionarily stable strategies in the evolutionary game of defense industrial cluster. Equilibrium strategy of the game mainly depends on the initial state of the system and the threshold P* and q*. When the initial state is in area OD, the system will automatically converge to (0, 0). The equilibrium strategies are non-cooperation. When the initial state is in area CD, the system will automatically converge to (1, 1).

The equilibrium strategies are cooperation. When the initial state is in area AD and DB, the direction of converge is uncertain. When the system's initial state is in the D region, small changes of the initial state will affect the final result of the evolution.

4. ANALYSIS OF THE FACTORS AFFECTING THE EVOLUTION OF DEFENSE INDUSTRIAL CLUSTER

In the development of China's defense industrial cluster, there are two long-run equilibriums: cooperation and non-cooperation. Cooperative equilibrium means civil-military integration is achieved and a new defense industrial cluster is formed.

Non-cooperative equilibrium means that the military and civilian enterprises are gathering only geographically, and have not yet formed a defense industry cluster. Equilibrium strategy of the game mainly depends on the initial state of the system and the threshold P* and q*.

And the initial state of the system is partly determined by the threshold. When the proportions of military enterprises and private enterprises who choosing cooperative strategy are less than the threshold P* and q*, the initial state will be in area OD.

When the proportions of military enterprises and private enterprises who choosing cooperative strategy are larger than the threshold P* and q*, the initial state will be in area CD.

Thus, the key factors controlling the evolution of defense industrial cluster is the value of P* and q*. The smaller P* and q* are, the greater the probability of cooperation will be.

From the expressions of P* and q*, we can see that P* and q* are mainly affected by four factors: profit of cooperation (a), distribution of cooperation profit (b), the amount of investment (v_i) and transaction cost(c_i).

4.1 The influence of cooperative profit distribution on the evolution of defense industrial cluster

Take partial derivative of P* and q* with respect to b, which is proportion of extra yield which civil enterprise obtained from cooperation, we can get $\frac{\partial p^*}{\partial b} > 0, \frac{\partial q^*}{\partial b} < 0$. The results show that the larger the proportion of the civil enterprises gains in the cooperation, more military enterprises choose not to cooperate, while more civil enterprises choose to cooperate. When the distribution of profit is more conducive to an enterprise, the enterprise will be more motivated to promote cooperation.

4.2 The influence of profit of cooperation on the evolution of defense industrial cluster

Take partial derivative of P* and q* with respect to a, which is the extra yield generated by cooperative program in defense industrial cluster, we can get $\frac{\partial p^*}{\partial a} < 0, \frac{\partial q^*}{\partial a} < 0$. When the yield increase, the value of p*, q* will decrease, the probability of forming a defense industrial cluster will increase. On the contrary, when the yield decrease, the value of p* and q* will increase, the probability of forming a defense industrial cluster will decrease. This means that the increase of expected revenue will lead to the increase of possibility of forming a defense industrial cluster.

4.3 The influence of the amount of investment on the evolution of defense industrial cluster

Take partial derivative of P* and q* with respect to v_i, which is the amount of capital invested in cooperative program by military enterprise or civil enterprise, we will get $\frac{\partial p^*}{\partial v_1} < 0, \frac{\partial q^*}{\partial v_2} < 0$.

When the amount of capital invested in cooperative program increase, the value of p*, q* will decrease, the probability of forming a defense industrial cluster will increase. On the contrary, when the amount of capital invested in cooperative program decrease, the value of p* and q* will increase, the probability of forming a defense industrial cluster will decrease.

This means that the increase of investment made by military enterprises and civil enterprises may due to the increase of possibility of cooperation.

4.4 The influence of transaction cost on the evolution of defense industrial cluster

Take partial derivative of P* and q* with respect to c_i, which is the transaction cost of military enterprises and civil enterprises , we will get $\frac{\partial p^*}{\partial c_1} > 0, \frac{\partial q^*}{\partial c_2} > 0$.

When the transaction cost decrease, the value of p^*, q^* will decrease, the probability of forming a defense industrial cluster will increase.

On the contrary, when the transaction cost increase, the value of p^* and q^* will increase, the probability of forming a defense industrial cluster will decrease. This means that the increase of transaction cost may due to the decrease of possibility of cooperation.

5. CONCLUSION

In order to analyze the behavior of military enterprises and civil enterprises in the evolution process of defense industrial cluster, this paper construct an evolutionary model for analyzing the evolution mechanism of China's defense industry cluster based on evolutionary game theory.

The results show that, in the development of China's defense industrial cluster, there are two long-run equilibriums: cooperation and non-cooperation. Cooperative equilibrium means civil-military integration is achieved and a new defense industrial cluster is formed. Non-cooperative equilibrium means that the military and civilian enterprises are gathering only geographically, and have not yet formed a defense industry cluster. Equilibrium strategy of the game mainly depends on the initial state of the system and the threshold P* and q*. And the initial state of the system is partly determined by the threshold.

On this basis, the paper analyzes the factors affecting the development of defense industrial cluster. The analysis indicates that there are four factors have significant influence on the long-term equilibriums: profit of cooperation, distribution of cooperation profit, amount of investment and transaction cost. In order to promote the forming of defense industry cluster, we need to proceed from the main factors above.

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A STUDY ON THE IMPORTANCE OF THE DETAILS IN THE TECHNICAL EXPERTISE OF THE TRAFFIC AND AERONAUTICAL ACCIDENTS

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Abstract: *one of the aspects which are in many situations superficially treated in accidents investigations is the careful analysis of the details to be revealed by the study of the official documents folder, the place of the accident, the technical systems involved in the accident or the testimonials. There were a lot of situations when two words or a millimeter aspect from a "hidden" corner of a testimonial or a photography have changed the main direction of the accident technical expertise (investigation).*

Keywords: *accidents investigations, technical expertise, investigator, accidents details*

1. INTRODUCTION

The occurrence accidents during the exploitation of technical systems is an unwanted phenomenon but they will be permanently present regardless of the methods used to avoid them. Despite the remarkable increase in the technical equipment's reliability in modern time, the hazard and the human mistakes will continue to cause accidents.

The new concept of the hybrid engineer, which is now present in aeronautical and automotive engineering, largely influences the process of the accidents' technical expertise from these areas. That means that an aeronautical and automotive engineer must be multidisciplinary specialized (in mechanics, electronics, automatics and especially informatics) in order to understand the complex technical systems from now on. A technical investigator must respect the same thing because what we have stated in the first sentence of the paragraph has large implications onto the accidents analyses. Otherwise, the Re-engineering concept is met more and more often in the synthesis analyses of the evolution of the nowadays aeronautical and automotive engineering. That means that traditional engineering must be multidisciplinary changed.

On the one hand, this thing causes a good effect because, for example, in aeronautics the multitude and the complexity of the "black box" data compensate, to a large degree, the lack of any physical signs. Speaking about traffic accidents, while technical experts usually have a lot of physical signs (on the place of the event, the damages of the car bodies, the wounds of the human victims), unfortunately, for the moment, they do not benefit from an accidents recorder (like the "black box" type).

We have to remark that in the last years in the field of automotive engineering as well, CDR (Crash Data Retrieval) gadgets have been used more and more extensively which could be linked to the main ECU or airbag ECU of the vehicles. Therefore, they could be used as EDR (Event Data Recorder) gadgets.

Unfortunately, not all vehicles permit these data to be read despite their utility in accidents analysis. In other situations, CDR can read the data but the data provided are not complete. Until EDR becomes mandatory and until it becomes mandatory to reveal accidents data from EDR completely, traffic accidents technical analyzers will continue to study the events by using classical methods.

Therefore, one of the aspects which are in many situations superficially treated is the careful analysis of the details to be revealed by the study of the official documents folder, the place of the accident, the technical systems involved in the accident and the testimonials. There were a lot of situations when two words or a millimeter aspect from a "hidden" corner of a testimonial or a photography have changed the main direction of the accident technical expertise. Also, the presence of a magnifier into the traffic specialist pocket is absolutely necessary because this little object can find out in each moment some hair beneath of a car paint layer, some burned spots or a deep plunged rived on the ploughing where an airplane just crashed. The experts' meticulosity must be one of his basic features.

2. STATE OF ART

Despite the sometimes excessive publicity, flight is safer than it appears to be. Definitely safer than driving. It depends on the way one defines flight and driving safety. Neither flight nor driving is safe if safety means that an accident is impossible to happen. Following this logical stream, there are permanent concerns with an increase in the safety standards for flight and driving. The aim is to remove all the reasons for which accidents occur.

But hazard cannot be completely removed. For example, the impact of some flying objects with the aircraft's aerodynamic surfaces could lead to getting into the unwished "Deadly Area" of the pilot and some passengers. This term was imposed by the Paul A. Craig in The Killing Zone, How and Why Pilots Die [2001, "The McGraw-Hill Companies"]. And this accident is produced exclusively by hazard. The same thing can be said about the situation when some obstacles may suddenly appear on the road just in front of the vehicle. Unfortunately, traffic accidents are not analysed in so much detail as far as the cause of the events is concerned, or they are treated very superficial.

3. EXAMPLES OF DETAILS WHICH MIGHT HAVE BEEN MISSED AND WHICH INFLUENCED THE FINAL CONCLUSIONS OF THE ACCIDENT'S TECHNICAL EXPERTISE

3.1 The observation of a photographic detail (the photo was taken immediately after the accident)

The tactical situation to be analysed: on a "T" crossroads a cyclist does not yield to a car and they impact as it is simulated in Fig. 1. The impact speed of the cyclist is requested.

When the expert analyzed the photos taken immediately after the accident he noticed a detail which had escaped the first police investigators: there was a cap on the hood of the car. He requested the police to ask the witnesses whether the cap belonged to the victim of the accident (the cyclist). The witness confirmed the suspicion of the expert: the cap belonged to the cyclist.

Returning to the aim of the investigation (the bicycle speed on the impact), statistically, the speed of the cyclist can be estimated by taking into account the age and the sex of the cyclist and the type of bicycle. In this case, the expert estimated the speed of the bicycle as approximately 13 km/h.

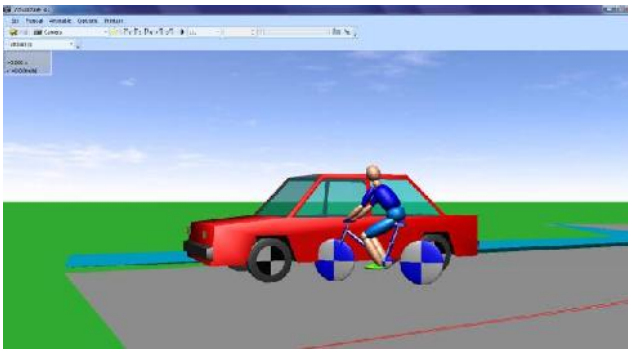

FIG. 1 The impact position

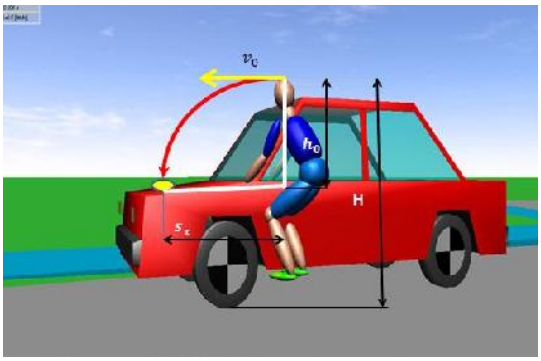

FIG. 2 The forces and the distances

Taking into account this important detail (the cyclist's cap on the car hood), the speed of the bicycle in the moment of impact can be cinematically calculated considering that the cap was a material point thrown horizontally. It was under the influence of the variable uniform moving laws. It was under the influence of the gravitational force on the vertical (Oy coordinates). So, the situation can be simulated as in Fig. 2.

In Fig. 2 one can see the PC Crash 10.1 cyclist model who is already thrown from the bicycle because of the car impact. The bicycle cap from the car hood is marked in yellow.

The others sizes from Fig. 2:

v_0 – the initial speed of the cap thrown, which is the same with contact/percussion car/bicycle speed

s_x – the maximum distance to which the cap was thrown

h_0 – the height from which the cap was thrown (related to the car hood area it finally reached)

H – the height from which the cap was thrown (related to the ground).

Simplifying assumptions:

- H is considered 1,65 m, taking into account that the cyclist's height was 1,59 m and in the moment of his being thrown he got up from the bicycle saddle; the kinetic energy due to bicycle moving dissipated in pottential energies difference due to altitudes difference (leap from the saddle of the body up and in the front);
- the difficulty of plucking the cap was not taken into account;
- the final cap sliding on the car hood was not taken into account; the last two assumptions compensate one another.

FIG. 3 h_0 measurement

FIG. 4 s_x measurement

Some measurements were made in order to find out the values of s_x and h_0. A similar vehicle was used. (look at Fig. 3 and Fig. 4).

The measured values were:

s_x = 1,38 m;

$h_0 = H - 0{,}94m = 1{,}65\text{-}0{,}94 = 0{,}7\ m$.

So, we now have all the necessary values to calculate v_0 using the formula:

$$v_0 = \frac{s_x}{\sqrt{\frac{2h_0}{g}}} = \frac{1{,}38}{\sqrt{\frac{2 \cdot 0{,}7}{9{,}81}}} = 3{,}65\ {}^{m}/_{s} = 13{,}15\ {}^{km}/_{h} \quad (1)$$

So, it means that the bicycle speed in the impact moment was 13,15 km/h.

This value is approximately the same with the speed statistically established (13 km/h). That means that the calculus is correct! The technical expertise will continue using the value of the impact bicycle speed 13,15 km/h (3,65 m/s).

3.2 The detailed analyzing of the physical evidence on an overturned vehicle

The tactical situation to be analysed: a Dacia Logan vehicle tries to overtake two other vehicles when a hollow appears in front of it unexpectedly. The driver violently braked before passing it until after passing it. After some distance, the control of the vehicle is lost, in first instance the car turns sharply to the right, hits the left rear part of the the second overtaken vehicle body, turns again more sharply to the left. Because of these sharp changes of directions the vehicle overturned.

The reason for the loss of vehicle control is requested.

As an initially unremarked detail, the expert found out on the right front wheel two damages (bends) of the rim edge (look at Fig. 5).

Thus, the film of evolution for the Dacia Logan involved in the accident can be re-enacted: the driver tried to overtake two other vehicles from one maneuver, he saw the cavity from Fig. 6 and he sharply and unjustifiedly braked till the right front wheel of his car went into this cavity (the brake pedal is used). In this moment the wheel rim edge suffered first damage (it is marked in red in Fig. 5) and it suddenly lost the pressure. This thing caused losing the steering stabilization of the vehicle. The vehicle skidded and in first instance went sharply to the right.

FIG. 5 The damages of the right front wheel

In this moment the vehicle could not be controlled by the driver and it hit the left behind part of the Audi vehicle (the second overtaken vehicle) as it can be seen in Fig. 8 and Fig. 9. On the impact with the Audi body the right front wheel of the Dacia Logan suffered the second damages (yellow marked in Fig. 5).

FIG. 6 The cavity which caused the loss of steering stability)

FIG. 7 Skid evidence after the loss of pressure from the wheel

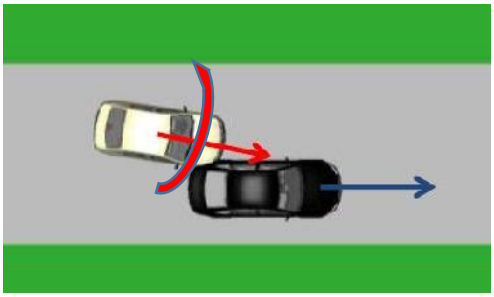

FIG. 8 The act direction forces outline

FIG. 9 The impact

Due to impact with a heavier vehicle, the Dacia Logan car is violently thrown to the left until the front part of the body reached the grass from the left part of the road. This caused the overturning of the vehicle.

CONCLUSIONS

In this paper we presented only two examples of details which were initially missed. One of them was observed on one picture taken immediately after the accident and the second was seen on one of the wheels which were damaged after the event.

Other possible places where this kind of the details can be seen could be the medical certificates of the victims (or autopsy certificates) or the spots-evidence which can be detected using the magnifier on the place of accidents, body of technical equipment, or on the material or humans scraps.

Here is how the analysis of apparently unimportant details, which can be missed by the first investigators, can bring clear evidence about the film of the accidents and they can be first importance factors in order to discover the real causes of the accidents. Establishing these real accident causes should be materialized in "lessons learned" which can lead to the disappearance of many accidents and to an increase in the safety of flight and road traffic.

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PROCEDURE OF DETERMINING THE MAIN CHARACTERISTICS OF INTERNAL COMBUSTION ENGINES WITH LAND & SEA DYNO-MAX DATA ACQUISITION SOFTWARE AND TEST BED

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Abstract: *The aim of the article is to present and evaluate the results of a internal combustion engine with the Dyno-Max Software and the test bed, which has a high applicability in the field of internal combustion engines and automobiles as well as the peripheral related equipment. For research it was used a Chevy 350 engine with a 350 cubic inch (5.7-liter) small block V8 with a 4.00 and 3.48 inch bore and stroke. The base version of this engine makes 195 horsepower and features an 8.5 compression ratio.*

Keywords: *combustion engines, Dyno-Max Software, test bed*

1. INTRODUCTION

Dynos Software and equipment it is used in field of automotive (auto engine, axel-hub engine, chassis, kart, motorcycle, tractor, truck- heavy duty, see FIG.1), marine, industrial but also for manufacturing prototypes of products custom made.

(a) heavy-duty (20"roll) AWD systems for multi-axle trucks

(b) single-axle, dual-axle, and even AWD tri-axle dynos

FIG. 1. Land & Sea's DYNOmite Truck Chassis Dynamometer Systems combine super-duty frames and rollers with DYNO-MAX™ software for sophisticated industrial diagnostics and power testing.

"Pro" Docking Station Dynos (right) include: stationary heavy-duty steel absorption frame, quick-clamp engine cart with adjustable mounts, telescoping driveshaft with U-joints and hinged guard, 13" toroidal flow water-brake absorber, CW starter (accepts optional second CCW starter), electronic auto-load servo, DYNOmite data-acquisition computer, bidirectional full-bridge load cell, battery compartment.

"Pro" console, stainless-braided hoses, engine-temperature thermistor, thermostatic coolant tower, illuminated wiring/coolant and wiring subsystem with full-function data harness. (AC absorber optional.)

DYNO-MAX™ software option creates a full engine dynamometer lab on your Windows PC. Features include: real-time trace graph display, adjustable voice/color limit warnings, pushbutton controls, plus user configurable analog and digital gauge ranges. Publication-quality color graphs and detailed reports are available for printing or even importing into other programs. With appropriate automated electronic loading and throttle control hardware options, operators can easily execute complex race simulations and engine test cycles, see FIG 2. [1]

(a) Stationary Test Stand Dynos (b) Mobile Test Stand Dynos

FIG. 2. The Test Stand Dynos

The Chevrolet small-block engine is a series of automobile V8 engines built by the Chevrolet Division of General Motors. The particularity of this engine generation is that the General Motors are using the same basic engine block. [2] The Chevy 350's V8 block is one of the most productive engines in history with many variants. On this type of engine it can be performed representative tests. [3]

2. THEORETICAL ASPECTS

The typical engine dynamometer test cell example it consists from CO Detector, windows, sound-bloc wall, load control valve, PC Cameras, air compressor, absorber return line, engine cooling tower, water-brake absorber, supply-water tank, sump pump, water-pressure regulator, bladder surge tank, centrifugal supply pump, fuel tank. (FIG. 3) [4]

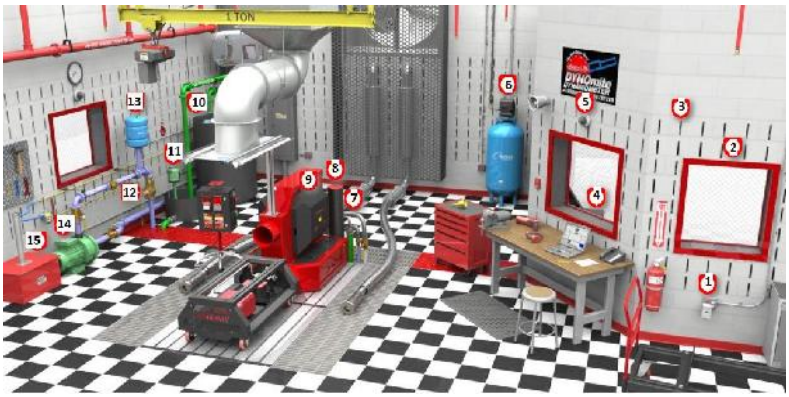


FIG. 3. The typical engine dynamometer test cell

In Table 1 are detailed the components of the typical engine dynamometer test. This configuration can be achieved in a high performance test with the test bed. Similar opportunities for optimally matching components and streams exist in considerably more complex systems for power and torque test. [5]

Table 1. Main parts of the typical engine dynamometer test

Nr.	Label	Specification
1	CO Detector	Carbon monoxide alarm digitally monitors the cell's CO levels and sounds an alarm above safe limits. Place low to floor for earliest warnings against dangerous exhaust leaks.
2	Windows	Sound-rated windows feature multiple panels of thick (1") laminated fire-rated safety glass with solid-concrete filled steel frames.
3	Sound-Bloc Wall	Sound-absorbing acoustical-lined chambers in thick (8"-12") concrete block and sand-filled cores, provide great sound attenuation, reduced echoing and excellent fire rating.
4	Load Control Valve	Manual or electronic servos valves control the absorber's fill level (loading) during testing.
5	PC Cameras	Networked cameras provide extra control-room eyes, with optional recording, into test cell activities.
6	Air Compressor	Air-compressor and storage tank provide regulated air for pneumatic service tools and other equipment - in both test cell and general shop.
7	Absorber Return Line	Unsubmerged drain line(s) from absorber to sump tank or city sewer.
8	Engine Cooling Tower	Cooling-tower assemblies provide thermostatic controll to maintain precise engine temperature with minimal water usage
9	Water-Brake Absorber	Water-brake dynamometer absorbers are the most cost effective loading devices available for engine testing.
10	Supply-Water Tank	Unpressurized water storage tank
11	Sump Pump	High-volume high-temperature sump pump - used to transfer absorber discharge water from a small gravity-drain tank to a verticaly-higher main supply tank.
12	Water-Pressure Regulator	Very-high-volume pressure reducing valve limits pressure to load-control valve to 60-PSI maximum
13	Bladder Surge Tank	Air-charged bladder tank, prevents "water hammering" as load control valve rapidly opens and closes.
14	Centrifugal Supply Pump	High-volume low-pressure pump delivers 40 to 60-PSI to load control valve.
15	Fuel Tank	Small-volume fuel cell provides safe storage of test fuel.

The standard document has been produced by the Society of Automotive Engineers to provide a standard method of obtaining repeatable measurements that accurately reflect real world engine performance. The software has a equation background and some of the basics mathematical. Calculation model and validation is made after many formulas like:

$$Power = EngineSpeed \times Torque$$

$$P[kW] = \frac{2\pi[rad]xN[rpm]x\tau[Nm]}{60[rev/\min]} \tag{1}$$

$$SweptVolum = \frac{\pi \times BoreDiameter^2 \times Stroke}{4} \tag{2}$$

$$V_{Swept}[mm^3] = \frac{\pi \times (b[mm]^2) \times s[mm]}{4} \tag{3}$$

$$BreakMeanEffectivePressure = \frac{P}{V_{swept} \times N} = \frac{\tau}{V_{swept}} \tag{4}$$

$$FuelMassFlowRate = \dot{v}_{fuel} \times Density\_of\_Fuel = \dot{v}_{fuel} \times Fuel\_Specific\_Gravity \tag{5}$$

$$\dot{m}_{fuel}[kg/hr] = \dot{v}_{fuel} \times \rho_{fuel} \tag{6}$$

$$SpecificFuelComsumption = \frac{\dot{m}_{fuel}}{P} \tag{7}$$

$$AirFuelRatio = \frac{\dot{m}_{air}}{\dot{m}_{fuel}}$$

$$AFR = \frac{\dot{m}_{air}[kg/hr]}{\dot{m}_{fuel}[kg/hr]} \tag{8}$$

$$Lambda = \frac{AirFuelRatio}{StoichiometricAirFuelRatio} \tag{9}$$

$$MeanPistonSpeed = \frac{2 \times N \times s}{t} \tag{10}$$

For calculation of engine friction, the Chen-Flynn Friction model is used. The equation used to calculate friction is given below:

$$FMEP = A_{cf} + \sum_{i=1}^{ncyyl} [B_{cf}(P_{\max}) + C_{cf} \cdot (S_{fact})_i + Q_{cf} \cdot (S_{fact})_i^2]$$

$$S_{fact} = RPM \cdot \frac{stoke}{2} \tag{11}$$

where: A_{cf}, B_{cf}, C_{cf}, Q_{cf} need user input according to parameters of the calculation engine (the value of FMEP is modified using the test data for this study); P_{max} is maximum cylinder pressure; RPM is cycle-average engine speed; stroke is cylinder stroke. [6]

For calculation of the power correction factor it will be used the formula:

$$P_{corrected}[kW] = P_{observed}[kW][1.18\left(\frac{99}{p_{air}[kPa]}\right)(\{\frac{T_{air}[^oC]+273.15}{298.15}\}[K]-0.18)] \tag{12}$$

3. EXPERIMENTAL RESULTS

A mainly used in applications that require a high power output and a reliable, small size and lightweight power producing system. One of these applications it can be made with the Dyno-Max Software and the test bed. After a demonstrative feature of the tested engine it can be seen hat the all the need parameters are monitored and analyzed. On Table 2 are more detail on the engine model. [7]

Table 2. Engine Model used for the test

Engine Model	350 Chevrolet	
Engine Description	Crate Engine	
Bore	4,000	inches
Stroke	3,480	inches
Air temp	55	degree F
Barometric pressure	38,25	in Hg
Weight	3450	lbs
Descrintion	1988 Chevrolet Coivette Coupe	

The results demonstrated the accuracy and precision that it proves especially when raising the power needs to enrich high performance. Results from the engine model 350 Chevrolet used for the test show exactly the same quantitative performance guaranteed by the manufacturer. Table 3, FIG. 4 [8]

Table 3. Results from the engine model 350 Chevrolet used for the test

RPM (RPM)	Hp(Hp)	Torque(ft-lb)
1700	119.9	360.9
1000	125.9	368.0
1900	137.2	379.5
2000	145.2	381.0
2100	149.9	374.8
2200	156.7	374.3
2300	166.8	380.8
2400	175.1	382.8
2500	187.2	393.5
2600	195.5	394.5
2700	197.9	384.9
2800	204.6	384.2
2900	214.3	383.7
3000	221.3	386.9
3100	230.2	390.7
3200	235.8	386.0
3300	242.1	385.8
3400	246.8	380.9
3500	253.0	379.8
3600	255.2	371.7
3700	258.9	367.6
3800	262.3	363.0
3900	271.0	365.0
4000	276.8	363.4
4100	273.5	350.2
4200	275.3	344.4
4300	270.2	329.3
4400	268.1	320.0

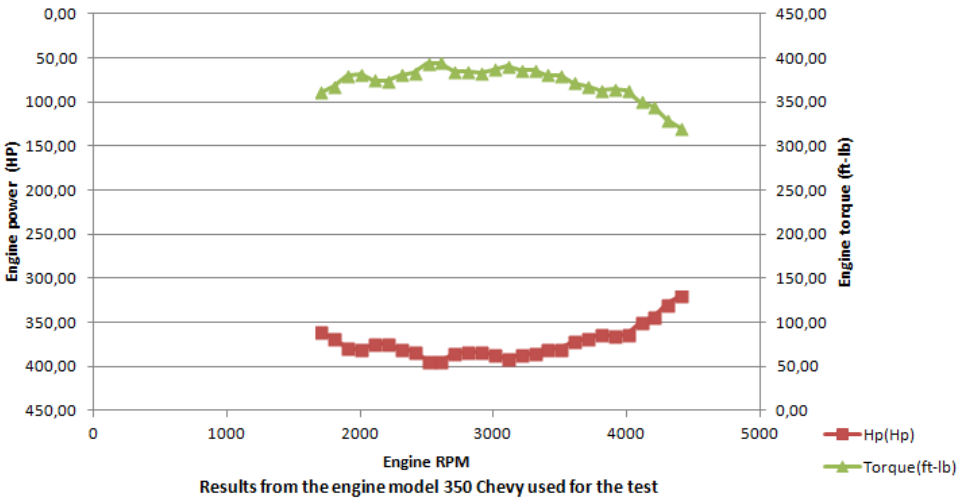


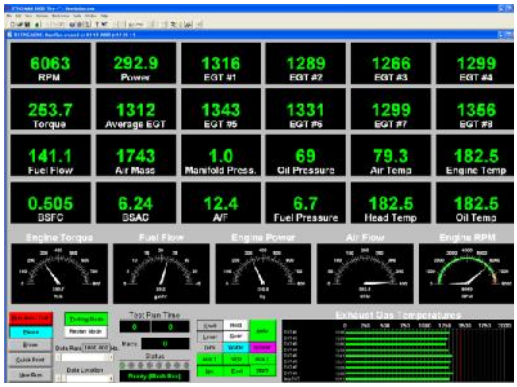
FIG. 4. Diagram of the results from the engine model 350 Chevrolet

Even if due to the fact that the test parameter can may vary slightly on a tolerance of 2-3% but no more, that fact is assumed by the variables like medium temperature, air pressure. During the study on a test bench in the form of a chainsaw the acoustic characteristics and the hydraulic resistances of the created silencers were determined. According to the obtained results of the research the most effective method is to use the same fuel, to repeat the test in the same period of time. [9]

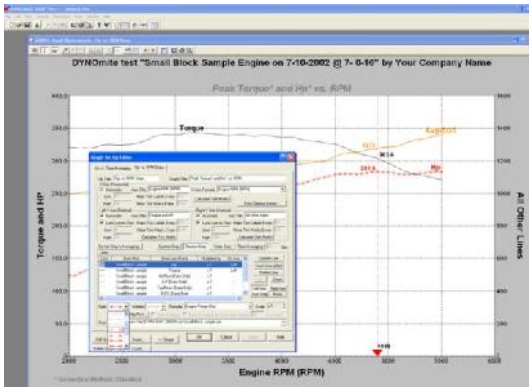
The proposed solutions are experimental. It can be seen that the higher peak of the test it is at the 4000 PRM were we have 276 HP and 363,4 ft-lb. The analysis of scientific literature indicates the absence of a common approach regarding the internal efficiencies. [10] But modeling results for the internal efficiencies are up to 90%. The designed process and with an assumed maximum cylinder pressure of 150 bar simulation, the process can achieve an effective efficiency of more than 90%. [11] This results can be produce which at lower costs than other systems. [12]

In some case the calculation are made also to simulated steam mixtures is between 2 m/s and 8 m/s at a pressure of 1 bar. [13]

In FIG. 5 it can be seen the software interface of the Dyno Software while testing the engine parameters running though the test.



(a) DYNO-MAX "Pro" features numerous built-in consoles



(b) DYNO-MAX powerful graphing and data presentation tools

FIG. 5. The typical software interface of the Dyno Software while testing the engine parameters

4. CONCLUSIONS

With the DYNO-mite Dynamometer Software and data acquisition it is possible to test applications for the following domains like automotive, industry and also manufacturing more types of dynamite dynamometer systems than any other company - in the world. Products include: outboard, marine, or PWC prop-shaft hydraulic dynamometer, kart, RC, and snowmobile dyne kits, tractor-PTO trailer and towing (drag) dynamometers, data-acquisition, do-it-yourself dynamometer plans, and used dynes.

Another advantage would be the ease of use of software and logistics equipment. The results obtained are processed in the most efficient way possible and in the shortest time and the accuracy of data acquisition has minimal deviations.

5. ACKNOWLEDGMENT

I would like to thank the company Land & Sea, Inc., New Hampshire, United States of America and "Transilvania" University, Braşov, România for support.

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CONSIDERATIONS ON THE DYNAMIC SYSTEM STUDY: FROM DEFINITION AND CLASSIFICATION TO ANALYSIS AND INTERPRETATION OF BEHAVIOR

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Abstract: *The purpose of this paper is to present in a current, synthetic and graphic form, the concepts specific to the field of system theory. System categories, from the literature, are presented in their dynamics and their particulates. At the same time, we naturally proposed a non-exhaustive classification of systems, depending on linearity, time behavior, number of input-output variables, interaction with the environment, ecological, technological and social aspects. Our research also tracks the behavior of vibration-induced mechanical structures even during their operation. These requests are nonlinear and involve, as a rule, many variables; as such, the graphical representations of their behavior are particularly complex. Current work techniques - program sequences, software, applications - allow for the realization of such representations with increasing fidelity, and the results. with proven applicability, increase the interest of research for dynamic systems in various fields of activity.*

Keywords: *systems theory, dynamic systems, interaction in the environment, modeling*

1. INTRODUCTION

Since ancient times, from the Babylonians, natural and social phenomena have been present in everyday activities of people, mathematicians and engineers alike. As human society has evolved, especially from a technical and scientific point of view, their importance has continuously increased [6, 9].

The study of natural and social phenomena has gradually led scientists to create mathematical models that embody their main features in an abstract formulation. Long-term surveys have shown that both natural phenomena and social phenomena are evolutionary phenomena, with their own dynamics. The fundamental methods of research in the field of natural and technical sciences are therefore instrumental observation and measurement (Fig. 1) [2].

The concept of a system has emerged and developed over time as a result of highlighting common relationships and behaviors for a number of processes and phenomena in different fields, which allowed them to be treated structurally and functionally, in a unitary, system integrator [1, 3].

The system concept is known to us and we frequently use it in everyday life. We often talk about economic, political, social, philosophical, and technological systems. We are also familiar with particular systems, such as the monetary system, computer systems, communications systems, etc. [4]. In the literature, there are several definitions for the concept of system, some reflecting the tendency of defining the system in a general scope, others the tendency to customize for a certain area of knowledge.

The notion of system therefore has a broad scope, being frequently encountered in science and technology in all fields of human thinking and action, but it is almost always associated with a specification attribute. For example, phrases such as "automatic system", "transmission system", "information system", "signaling system", "production system", "social system" [1, 4] are used as special terms.

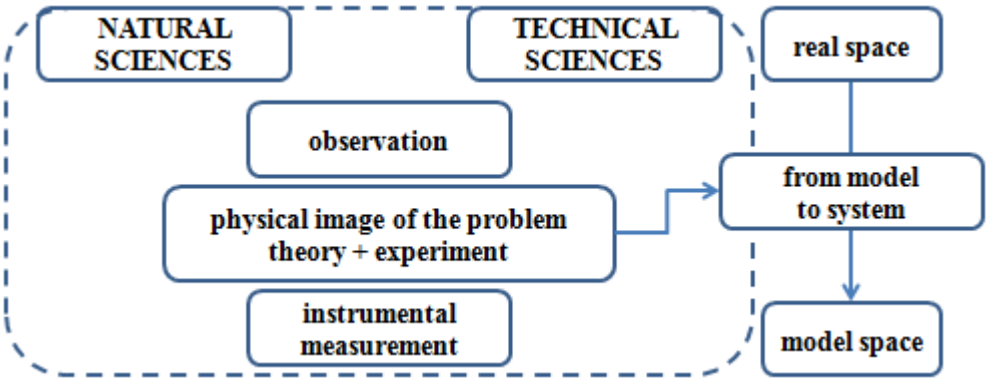


FIG. 1. Observation and instrumental measurement in relation to natural and technical sciences

In the sense of the present paper, we will understand through the system an ensemble of elements that interact both with each other and with the outside, on the basis of and with observance of laws and principles, in order to achieve a goal, a functionality. Interaction between the components of a system can give the system new properties, different from those of each component. In the case of physical (real) systems, interaction is performed on the basis of general physical-chemical laws, through mass and energy flows that carry information.

2. DEFINITION, CLASSIFICATION & MODELING OF DYNAMIC SYSTEMS

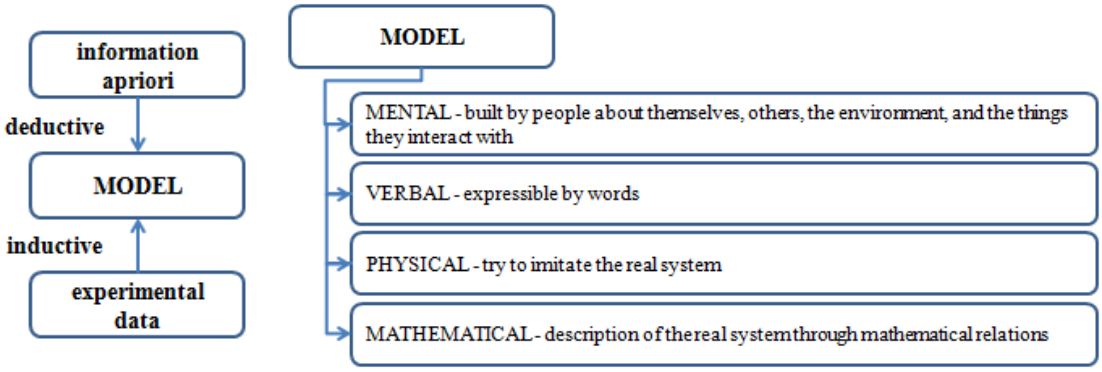
An almost equal importance to the concept of a system is the concept of building the model. The formulation of a theory can be called "model building". It is also possible to define the model as "a representation of the essential aspects of an existing system or of a system to be built, representing the knowledge of that system in a usable form."

Building the model can be based on two principles if there is knowledge and insight about the system. So we are talking about the white box component - if there is experimental input / output data from the system, and the black box component - if there is only a priori information (Fig. 2a).

In the vast field of science, there are few features that can not be described in mathematical terms or in few areas of interest that can not benefit models in the form of systems. The use of modeling and modeling has become an important tool in analyzing systems by enabling exploration of hypotheses that can not be easily tested by field or laboratory experiments.

Over time, representations of the model term have been proposed by many writers or researchers. Thus, Jackson et al. [7] propose an interpretation of the model by the idea of a particular representation of an idea or condition that varies in complexity from the simple form of attributing an action to a subject to the complex description of processes through mathematical equations.

From the perspective of other authors, the model is the formal description of the essential elements of a problem within a system of interest, sometimes even tools that help understand the way processes work and allow testing hypotheses in a systematic manner. On the other hand, Gillman [5] offers a simplified version, defining the model as a representation of reality. Another representation, this time much simplified, shows us four major categories of models, as shown in Fig. 2b.



(a) (b)

FIG. 2. a) Model construction options [2]; b) Various models and their representation [2]

It seems and it is really more complicated to classify systems. These are characterized by heterogeneity, variability in time and space, areas of thought and action, so one would expect a result of as many fields as possible. A classification and systematization of systems can be achieved by dualization as: *physical* and *abstract systems*, *dynamic* and *static*, *empirical* (*correlation*) and *mechanistic*, *simulative* and *analytical* etc.

Based on properties derived from the structural-unitary, causal-dynamic and informational nature of the systems, they can be divided into classes (categories). Systems belonging to a class have features, properties and similar behaviors [8]. In the following, according to [2, 8] we have structured, the main features for each mentioned systems:

- *linear systems* are those which under any circumstances verify the superposition principle (overlapping effects): the sum of the effects of the causes is equal to the effect of the sum of the causes. In other words, in a linear system the input signals are independent, so they do not interact within the system.
- *nonlinear systems* are those systems that do not satisfy the superposition principle in all cases. The nonconstructive way of defining nonlinear systems and the multitude of modes of manifestation of their nonlinearities lead to the idea of the impossibility of building a unitary theory of nonlinear systems.
- *continuous-time systems* are those systems in which input, status and output quantities take values at any time in the real-number set. Continuous time systems may be continuous (smooth or analog) or discontinuous. Continuous systems satisfy the property that for any initial state and any continuous input function (in mathematical sense), the state function X(t) and the output function Y(t) are also continuous functions. Continuous time systems that do not meet this property are discontinuous.
- *discrete time systems* are those systems in which input, state and output quantities only take values at certain discrete moments of time. Discrete time systems in which time discretization is uniform (constantly) are called discrete systems.
- *deterministic systems* are characterized by the lack of random variables and always provide the same predictions in the context of assigning a specific set of conditions.

- *non-deterministic* (*statistical, probabilistic, stochastic*) systems are characterized by the existence of a number of random variables and provide different predictions, in the context of assigning a specific set of conditions, the random variables within the model can take different values for each model run.
- *concentrated physical systems* are those where it can be considered with sufficient precision that physical quantities associated with any element of the system have the same value at all points of the element.
- *physical systems with distributed parameters* are those in which at least one physical dimension associated with a dimensional element of the system has values that differ sensitively from a point to another, it has distributed values along a line, plan, or space.
- *systems with constant parameters* (also called invariants or invariable over time) have a fixed structure and internal parameters constant over time, and *systems with variable parameters* (also called variants) have at least one variable that is internally variable over time. The state of a system with constant parameters initially in stationary mode can only be changed from the outside by the action of the input variables.
- *monovariable systems* have one input and one output. *Multi-variable systems* have at least two inputs and two outputs; In addition, at least one output is influenced by at least two inputs. Single-entry and multi-output systems as well as multi-input and single-out systems can be reduced to monovariable systems. Monovariable systems are also called single input-single output (SISO) systems, and multivariable systems are also called multi-input multi-output (MIMO) systems.
- *static systems* (called *non-memory systems*) are zero order systems (no state variables), with the output Y value at time t fully determined by the input value U at time t. In these systems, the output (in its totality) is instantly tracked (without delay) variations in time of entry. Static physical systems do not contain elements capable of storing and transferring significant amounts of mass and energy.
- *dynamic systems* (also called *memory systems*) have orders greater than zero and are characterized by the presence of transient regimes. Dynamic physical systems include elements capable of accumulating and transferring significant amounts of mass and energy at a finite speed.
- *open systems* are characterized by a one-way information flow.
- *closed systems* are systems where a bidirectional information flow can be highlighted, whereby the output size of a system element influences the future state of that element through other elements of the system.

3. PROBLEMATICS & NECESSITY FOR DYNAMIC SYSTEMS STUDY

An important category of systems with which literature is operated is the one inspired by natural phenomena and processes. These, as we know, have a pronounced evolutionary character [1, 2]. As such, the systems considered are dynamic and follow their own laws, defining for the researcher, to a greater or lesser extent, the status conditions of the evolutionary process itself that will retain our attention.

According to system theory, the study of such an evolutionary process involves selecting and then following a number of parameters that characterize the process or phenomenon (Fig. 3).

In mathematical language, this set of parameters represents the state of the system or process and forms a group of functions, always dependent on the time factor [3]. Dynamic systems are often described through the input-state-output formalism (pressure-state-response) as a set of first order differential equations. The choice of system states is the modeling process in which the created model will be verified [2].

The state of a dynamic and nonlinear system appears not only as an explicit function in terms of time, but also as a solution to an equation or system of equations that in fact describe a natural law that governs the phenomenon.

The number of status parameters required to be considered for a pertinent characterization of the status of a dim system is the number of degrees of freedom of the state. Time-varying dimensions, which define the degrees of freedom of the system, are called generalized coordinates.

The need to study dynamic systems appears as a result of attempts to better know and periodically control mechanical systems prone to destruction, damage or dysfunction as a result of the vibrations associated with their dynamic operation.

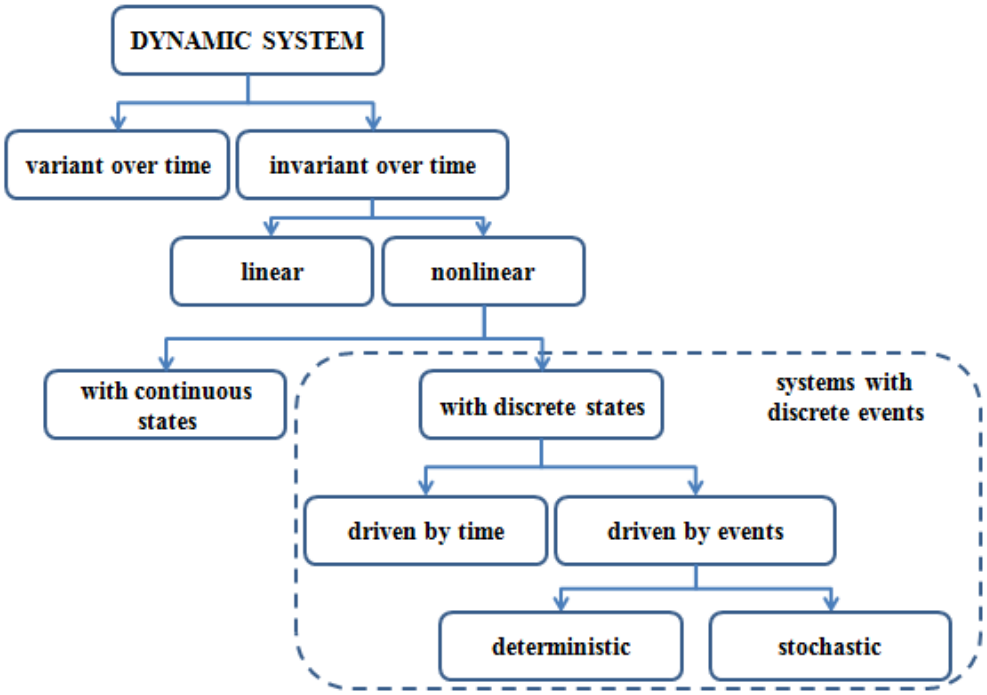


FIG. 3. Overall classification of dynamic systems

The main types of problems associated with the theoretical and experimental analysis of vibrations of mechanical systems derive from their shematic representation:

- *initial modeling of dynamic system behavior* - consists in determining the R system response to a known P disruption, knowing the block S (ie the structure of the system and the values of the parameters that define it).

This is of particular practical importance, especially in the design phase of structures, as it allows more or less accurate estimation of the dynamic demands to which the structure will be subjected in operation. This approach creates the possibility of optimizing by calculation (genetic algorithms) of the S block with respect to different reliability criteria and imposed functional performances.

- *identifying affected system elements* - consists of identifying on an existing structure model (block S) when it is known by direct measurement the R response to P-perturbations determined under operating conditions or laboratory conditions.

In this case, inverse methods are applied, ie one or more parameters of the analytical model are changed until the cost function adopted for comparing the calculated response and the measured response R for the same perturbation P is minimum or small enough from the practical point of view.

This process is intended to induce some vibrational modes. Their comparison with their respective proper modes and frequencies, obtained by calculation for the dynamic system, allows the correct dimensioning of some system parameters.

- *determination of disturbances* - presupposes the very accurate knowledge of the block S corresponding to a physical structure as well as the response R to the perturbation P to be determined.

In fact, this is a measurement problem, the structure being in this case even the tool that does not have to significantly affect perturbation, being calibrated and framed in a certain class of precision. In this regard, laboratory vehicles are used to determine the disturbances induced by the bumps of the transport ways. The description with a satisfactory approximation of the perturbations to which different types of structures are subjected is essential for the correct resolution of the problems encountered.

4. ANALYSIS & INTERPRETATION OF DYNAMIC SYSTEMS BEHAVIOR

The methods of analysis of the behavior of mechanical dynamic systems and associated random vibrations have been steadily developing over the last decades due to the high requirements of designing structures and equipment with superior functional performance with high reliability at complex loads during their operation. Examples of this are the demands caused by the turbulent flow of fluids, the dynamic loads caused by the movements due to earthquakes, wind, waves, and runway unevenness.

A common feature of these types of demands lies in the impossibility of describing their evolution in time deterministically as a result of the behavioral dynamics of the whole system (the black box concept) [2]. The dynamic behavior of random mechanical systems is also described by a series of stochastic differential equations whose treatment depends essentially on how random factors intervene.

Thus, the following types of equations were established [4]: *differential equations with random in situ conditions* - with an important role in statistical mechanics, statistical thermodynamics, a priori analysis of spacecraft trajectories; *differential equations with random coefficients* - used in the study of systems whose parameters have imprecise values due to material or execution imperfections, inherent or random variables, such as the case of objects on a conveyor belt; *differential equations in which the random part enters as a non-homogeneous term* - representing in fact the external disturbance applied to the system as a random function of time (random process).

Of these possible states, the last category of equations has the widest field of application, being used mainly in modeling the dynamic behavior of mechanical structures, namely road and railway vehicles, heavy-duty ships, aircraft, civil and industrial buildings, heavy machinery , machine tools, etc.

The whole approach of the system analysis methodology is based on the idea of the possibility to continuously improve and improve the performances of any system by analyzing the existing system and designing a more efficient system. In such a complex process, specific stages of analysis, design and calibration are considered, steps necessary to make the transition from the real physical model to the real mathematical model, as is also shown in Fig. 4a.

Of the methods currently known, simulation is the method that allows the analysis of complex processes, reproduced by generating events similar to those actually occurring. This method is used to test the project variants for the best selection, to evaluate the performances of the new system implemented, and to analyze and control the behavior of a system (Fig. 4b).

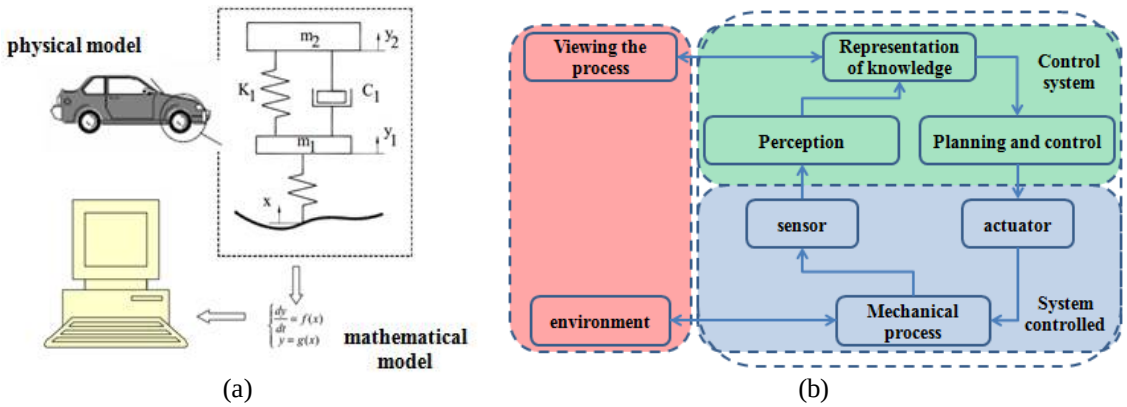


FIG. 4. a) Systemic Analysis Methodology; b) Analysis and behavioral control of a dynamic system

The simulation requires a large amount of data, but it can reveal hidden links or system imperfections that may occur later in life. Informational methods - ubiquitous in analyzing and designing performance systems, as well as implementing expert systems and decision support systems - use or combine methods of analysis from classical methodologies, and successfully pass the transition from a partially controlled system to a totally controlled system.

5. CONCLUSIONS

Because most natural and technical systems are nonlinear dynamical systems, ie systems characterized by the presence of chaotic (non-deterministic) behavior, the study, respectively their definition and characterization, the classification and the analysis of the control possibilities require the use of the most diverse working methods. There are suitable methods of modeling, simulation, analysis-diagnostics - mostly informative, current methods and with the possibility of approaching some multicriterial analysis sequences.

Mechanical dynamic systems used in the technique for over a century (road and rail vehicles, ships, aircraft, civil and industrial construction, machinery, machine tools, etc.) have the mathematical formalism of input-state-output (pressure- answer). It refers to dynamics involving many state variables that make modeling difficult in itself. Current work techniques - program sequences, software, applications - make it possible to create more and more fidelity representations, and application results increase the interest of research for dynamic systems in many fields of activity to limit negative effects and dysfunctions, both in inside the system considered, and in the external environment.

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ECOLOGICAL INTELLIGENT HOUSE BETWEEN MIT AND REALITY. AUTOMATIC VS. DOMOTIC HOUSES

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Abstract: *Lately, even in Romania, the interest in intelligent (ecological) houses has begun to take on proportions. Gifted with curiosity, but above all by reorienting to a new lifestyle, people are looking to find out more about them. Although the construction of intelligent houses is not simple, but eliminates many of the harder stages of a classical construction, the future homeowners omit, due to lack of information, this variant, especially in the context in which we do not yet have a good information filter on this subject, which will concretely give us the benefits we can provide, especially if we refer to domotic systems. Through this paper I would like to emphasize a number of elements to be considered in the context of moving from the current ecological house to the intelligent house, elements that are mainly related to the correct understanding of the intelligent house concept - risks and flexibility, advantages and disadvantages, estimates of funding and so on.*

Keywords: *intelligent houses, upgrading trends, home automation systems, automated houses*

1. INTRODUCTION

About *intelligent houses*, it's been discussed for a long time. Lately, even in Romania, the interest in intelligent (ecological) houses has begun to take on proportions. Gifted with curiosity, but especially by reorienting to a new lifestyle, perhaps more comfortable, people are looking to find out more about them [1]. Although the construction of intelligent houses is not simple, it eliminates many of the harder stages of a classic building, the future homeowners omit, due to lack of information, this variant, in the context where we do not have a relevant information filter on this subject, to give us concrete benefits, especially referencing domotic systems [2].

Some authors speak enthusiastically about the *house of the future* as an excellent but distant idea (Fig. 1). Others say that the notion has already lost its credibility due to the great promises but not respected. Others consider *modern homes equipped with digital technologies* to be a contemporary embodiment of *smart homes* [3]. Finally, others believe in the reality and contemporaneity of intelligent houses, but deny the contribution of multimedia equipment to increasing the house intelligence [8]. Everyone is right in their own way, because nobody has yet defined human intelligence. Why would it be different for houses?!

However, we can discuss some elements whose presence is obligatory in a smart home: *sensors* that collect different information, *control elements* that allow control of home-based systems, a *communications network*, and a *central unit* running programs that record and monitor information, makes decisions and orders according to these decisions.

In addition, with the help of some *software interfaces*, the owner of the house can access all the information collected by the central unit, can call all the house orders individually or grouped in scenarios and configure how the house makes decisions [1-3].

FIG. 1. Overview of the Smart Ecological House concept (source: www.shaspa.com)

Through this paper, we want to highlight a number of elements to be considered in the context of moving from the current ecological house to the intelligent one and from house-to-home [4], elements that are mainly related to the correct understanding of the smart home - risks and flexibility, advantages and disadvantages, funding estimates etc.

2. SHORT HISTORY OF INTELLIGENT HOUSES EVOLUTION

Most of the achievements in the field of construction and home improvement have transformed the prehistoric cavern into the home that we have today. The next step towards completing this home is its automation - it transforms the usual *passivity of residence* into the *intelligent interaction of matter with human spirituality*. The home gets new valences, especially through the intelligence center (central unit) that controls most of its attributes [3]:

- *functionality* - controls lights, blinds, temperature, hi-fi systems, and any other electrical or electronic device, both inside and outside, either via the Internet or locally using remotes, laptop, touchscreen;
- *energy management* - reduces energy consumption by optimizing the operation of the electrical, electronic, sanitary and thermal components of the dwelling;
- *security systems* - allows the presence of tenants to be simulated during their absence, allows detecting and reporting burglary to neighbors, family, security firm, and triggering a predefined scenario for removal of intruders. Video surveillance also allows viewing the activity of children, bonuses and the entire residence at any time and at any distance, thereby increasing the effectiveness of the security system;
- *intelligence* - the smart touchscreen can serve as a control panel for home automation, also performing the intercom function, or allowing the Internet access, even outside the system;
- *comfort* - preset lighting scenarios for certain types of activities (party, dinner, film) requiring different levels of light intensity and multiroom audio-video - which allows via an audio-video server to listen to music or watch a show in each room of the house, according to individual preferences.

In recent years, the automation system for green houses has made tremendous advances in technology, applications and design. By enabling technology to enter the living space, people have improved comfort by making everything even more functional. The discovery of the advantages of home-made systems to a living space is possible thanks to the experience and technology, the specific know-how that has replaced the natural electronic systems with artificial intelligence systems (computational applications). The development of the idea of a smart ecological house in practice started from the "Smart House" comedy produced in 1999 as a film adaptation of Ray Bradbury's "The Veldt" - a series of smart gadgets (Fig. 2) transformed the lives of tenants house in a series of up-to-date SF scenarios that had a lot of publicity.

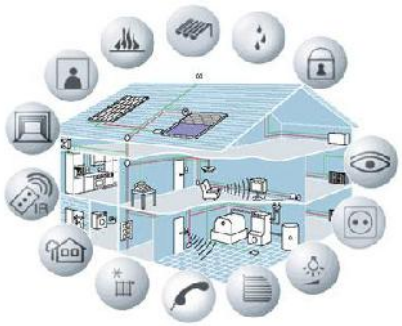

FIG. 2. The main attributes (domotic systems) of intelligent houses (source: /i45.servimg.com)

The success of the film gave thought to automation companies, and so the first elements of the intelligent house did not come to an end; although at first it was just about lighting, watering the garden, and video surveillance, the list of things that a smart home could make has grown considerably.

3. WHAT DOES THE INTELLIGENT HOUSE CONCEPT MEAN?

3.1 Principles of operation and behavior

The concept of "*smart house*", relatively new for Romania, appeared about 30 years ago and was implemented in most developed countries across Europe. The unprecedented expansion of the computer in all spheres could not affect the domestic domain. This is the reason for the emergence of *domotics* that deals with the applications of computers and robots in the household domain. The concept of "*intelligent house*" defines a modern living space that uses modern technologies for the automation of all life aspects (Figure 3), responding exactly to the basic human needs of *comfort*, *functionality* and *safety* [4,7].

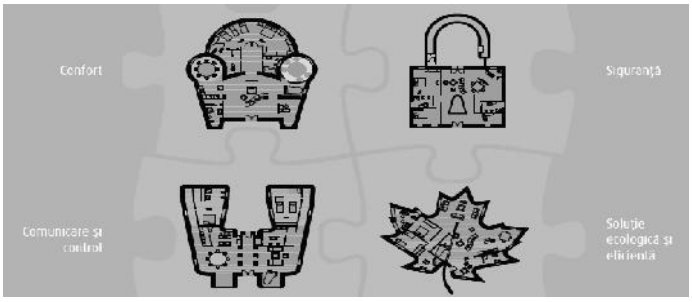

FIG. 3. Human fundamental needs of the smart home [1-3]

The role of an intelligent house is therefore to improve the comfort of tenants and to simplify their touch by *simply pressing a button* (the keys of a remote, telephone or other communication device) [6,7];

So many functions can be used to automate the house and its exterior, such as: controlling the lights in the yard, throughout the house or in certain rooms, and conditioning the rooms; family and property security; managing the multiroom audio system; manual or scheduled operation of blinds, curtains and blinds; operating the watering facility and controlling the water temperature in the pool; pet feeding, etc. In principle, all individual electrical and electronic systems in the house are combined into a single unit that makes centralized coordination of all functions possible, whether inside the home or remotely via the mobile phone or the Internet. Domotica also has an impact on protecting the environment by reducing energy consumption (eg when a window opens to interrupt the heating system) [5].

The general operating principle of an intelligent house consists in the networking of all household electrical appliances that are constantly controlled by a "centralized intelligence" (intelligent server) with an accessible interface. Orders can be made with a universal remote or via a portable phone, a touch screen, and more. All these elements make possible complex adjustments, adapted to the life of each tenant, by realizing and following "scenarios" that are activated (repeatable, in the form of a predefined circuit) depending on the situation (Fig. 4).

FIG. 4. Various reference scenarios for smart home [3]

For example, the "Going to work" scenario, with a simple click, would mean turning off the lights, opening the garage door, switching the heating system to a standstill and, of course, closing the shutters and the garage door within 15 minutes. Similarly, the "Return from Work" scenario determines actions in the opposite direction: the blinds rise, the boiler starts, the doors open, etc.

As far as security systems are concerned, they usually contain a video camera, audible and intrusion sound signals, while some more performing systems can automatically contact the owner's phone number or a security firm, whenever there may be a gas leak, a flood, smoke or "unwanted visits".

The realization of an intelligent (ecological) house implies, among others, a specific intelligence system (smart integrated kit) that makes everything functional, associated with a modern (ecological) nature inspired design while taking into account the elimination fire risks or other collateral damage, in compliance with established Building Management Systems (KNX) [8].

FIG. 5. Various benchmarks for intelligent house management (BMS, KNX)
(source: www.dmc-technology.com/knx-technology)

In the current market, KNX technology (those who have also produced the Internet, radio etc.) used by millions of customers in Europe, Asia and America (Figure 5) is the most appreciated. Also CEDIA, as an international professional association, produces furniture and electronically-integrated natural systems for smart homes, in collaboration with architects specializing in the design of ecological homes [8,9].

3.2 Technical and economic indicators

Nowadays a building no matter what its destination can not be without proper IT management to ensure its administration and maintenance under efficient conditions. Today's technology allows the development of computer-aided programs to set up a multitude of equipment and to execute, according to some scenarios, everything that is necessary and sufficient for the proper exploitation of the building and the habitat.

New technologies - Building Technologies - have been developed in the form of unitary systems integrating Building Management Systems (BMSs). Implementation of a BMS is aimed at: increasing the comfort of those living or operating in the building, building and people security, building safety, simplifying operation and maintenance operations, substantially reducing maintenance costs etc.

A home equipped with such a system offers more comfort, flexibility, elegance, ease, increased security, ambient, but the most important thing is to reduce maintenance costs by optimizing electricity and heat consumption. The systems are modular and extensible, which means they can be deployed partially and in stages, depending on the client's time requirements. In the world, there are many home automation manufacturers, some of whom are specially engaged in the development / implementation of various innovations or technologies, and others who are renowned manufacturers of classical electrical equipment and have approached this field of applications, aware of the impact which he will have on the real estate market in the future.

Sooner or later, all buildings will end up having such amenities. We are already talking about the BMS (Building Management System), without which no building is currently being designed, with a larger or smaller volume of work to be carried out.

One of the solutions on the US market and verified over time is the one proposed by the American company HAI (Home Automation, Inc.) founded in 1988.

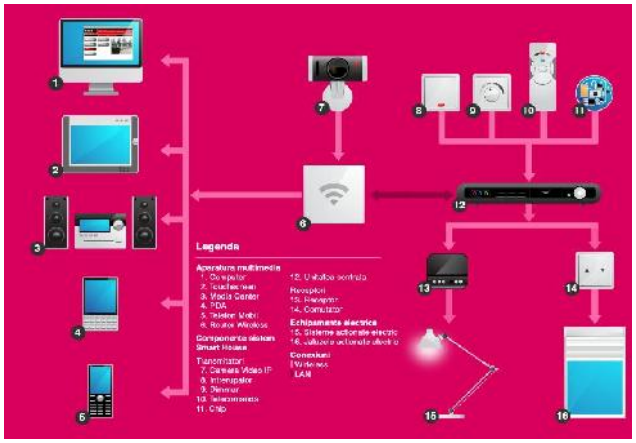

FIG. 6. The main components of the domotic system associated with the intelligent house (source: www.dti.ro/assets/images/content/arhitectura-sistem.png)

The HAI solution is modular and includes several systems that embody, to a greater or lesser extent, the options expressed by the customer. Regardless of which of the variants available on the market are preferred by the client, the following components are found (partially or fully) within the domotic system associated with the intelligent house (Fig.6): *the central unit* - which makes possible the unitary functioning of the system, having the role of multiplexer for the rest of the components; *console* - which allows programming of system components and system functions desired by the client; *omnitouch screen* - with complementary functions to the console, which visualizes the state of the entire system; *HI-FI system* - stand alone system that can be connected to the centralized central control unit.

3.3 Risks and flexibility. Estimates of costs

The multiplication of stress factors in the environment in which we live determines us to seek more and more solutions in order to create a balance between the tension and mental and physical stress of each day and the moments of relaxation; thanks to this, the intelligent house has become an increasingly familiar space, providing added value to any construction. Additionally, the computational systems of the intelligent house have evolved to an extent that responds to higher aspirations in terms of comfort, safety and control of the house.

IT systems that make the move from the green house to the smart ecological house extend the traditional concept of "electrical systems" perceived as simple lighting systems and sockets. The new concept basically means equipping the home with advanced electronic systems that are designed to meet specific needs, perfectly capable of providing useful applications. Integration of all these features creates an advanced but easy-to-use, time-lasting and highly flexible system that can be modified and expanded at any time to meet new needs.

An intelligent house has the property to provide that unique feeling of "I feel good at home," every day, turning the house into "home" in the true sense of the word. The intelligent installation blends in perfect harmony, control of all lights, sockets, heating, air conditioning, motorized shading equipment, audio-video equipment, security features, irrigation system and much more. Child safety, family comfort, energy savings, exclusion of electric shock hazard, circuitry presence simulation etc., all these benefits are really important for intelligent homes. In addition, a truly intelligent installation will need to be intuitive and easy to use in the everyday life of all generations, the tenants of the building. It also needs to be *adaptable over time* to meet *the new requirements of changing rooms* - not a few times, at a certain age, the child's room becomes unruly and will receive a new destination, and a larger room will become the onomastic gift.

A smart home will be able to provide all the features needed for the new room. The intelligent house provides the command or visualization of the equipment from any area of the property, including remotely when we are away.

Smart home projects, as *flexible and discreet control systems*, are becoming more widespread on the Romanian construction market, as a building is truly considered to be complete only when it offers besides shelter, a multitude of advantages: *low energy consumption*, *increased safety*, *easy maintenance*, *low environmental impact* through *optimization of consumption* and *substantial utility bill depreciation*.

Another aspect that is worth mentioning about the intelligent house is that the central home system can easily integrate a variety of systems such as: *climate control and light control, local and remote audio and video surveillance systems, home-cinema and audio-multiroom, electrical socket system, fire detection system, burglary or other incidents, the automation system of the entrance and garage doors* etc. All of these systems can be controlled at any time, manually, or by setting predefined scenarios for different daily situations: when you leave or return from work or vacation, when you wake up or go to sleep, when the whole family lives in the house, and so on Also, the flexibility of home-based solutions derives from their ability to implement and adapt to various areas: apartments, houses, villas, holiday homes, hotels, office buildings, etc. An intelligent house is domotically designed modularly so that it can be completed in time and in need with other components, which of course have adequate prices. Taking into account each piece of equipment that is very personally substitutable to humans in the form of domotic systems integrated into packages of different needs (for residences, hospitals, office buildings, etc.) it is found that the great disadvantage of an intelligent house is the high price high compared to classic electronic systems.

In Western Europe, for example, a traditional interior fitting (just the electrical installation) for a medium house as surface and comfort can reach 12-13 thousand euros, while a domotic system would require an investment of over 25 thousand euros, which would, of course, dampen through the substantial savings caused by the intelligent system in about 7-10 years in the opinion of the specialists.

The vast majority of companies that make smart homes systems available to the public support a reference price of around 40-50 euros/m^2 compared to 20 euros/m^2 for an ordinary electrical installation. There is, however, the choice of the beneficiary only of integrated intelligent systems packages, such as lighting or sound control, in which case it can reach 800-1000 euros for a 70m^2 apartment. The price differs depending on the complexity of the chosen system, ie the customer's needs to be met. A basic system from AVITECH, for example, starts from 10,000 euros, and one complex is around 400,000 euros for a villa. The target audience for such equipment is the high-income, high-income, self-realizing, high-status, loving and willing to convert their home into a special place in a place of indulgence.

3.4 Advantages and disadvantages of a smart home

The most common question is probably "Why does a smart home benefits us?" So we will try to answer you in the next few lines. In addition to the cool factor, intelligent homes ease the lives of the tenants, provide increased energy security and energy efficiency, not to be neglected today. If we talk about security, then we need to take into account scenarios where we no longer need keys, can use fingerprint authentication, voice, retina to open the entrance door. For example, we could give a remote friend access for a limited time if we are not home.

We can also access the video cameras in the house in real time to check out the new baby that I left to take care of the children.

And if an intruder has been detected, we can be notified immediately on the mobile phone along with the authorities that will no longer have to be notified by phone, as is happening today. On the energy efficiency side, think that a radiator forgotten when we go to the office consumes energy until we return home, even if empty housing is not to be kept at the same temperature of 20-22^{o}C as when we are home. We can also set household appliances to consume electricity only in times when the price per kW is lower.

In the future, other utilities such as water and heat may be priced differently depending on the period of the day, so any optimization of consumption in this sense will translate into low maintenance costs. On the entertainment side, wireless systems will allow virtual room partitioning and individual control from a central point. Possibilities are unlimited and will probably prove to be useful in the future.

Another important disadvantage is that anything connected to the Internet is vulnerable to cyber attacks. A good hacker is able to get into a secure environment, and smart homes will use the Internet connection to control access, so they're vulnerable. Changing stickers to security firms and antivirus manufacturers will not solve this problem. Informational attacks are a reality of today's day, unfortunately, so it is wrong to believe that we can not be affected by them. In addition, in a world of more and more intimacy, more data will be collected about us through Internet-based devices. And this must be considered and balanced before deciding to "wake up" our home.

4. CONCLUSIONS

The practical solution, leading to full and conscious control over the home, provided by the intelligent house, highlights the possibility of interacting with the artificial and natural environment. The natural-artificial symbiosis through the complexity of the functions behind a user-friendly interface, with customizable menus for easy accessibility, reveals that we need electronic systems and equipment to an acceptable level in everyday work that not to cause undesirable effects on the safety of the environment or society.

In recent years, the automation system has made huge advances in technology, applications and design. By enabling technology to enter the living space, people have improved the level of comfort by making everything more functional. The discovery of the advantages of home-made systems to a living space is possible thanks to the experience and technology, the specific know-how that has replaced the natural electronic systems with artificial intelligence systems (computational applications).

The coming years will be decisive in the maturing of smart home technology and the increased consumer interest will lead to the development of a diverse range of products more suited to meet the needs of automation of the space we live in. As I mentioned at the beginning of the article, the supply of intelligent home appliances is now quite limited, prices are high and standardization is lacking, but this will not disturb those who really want a smart home.

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THEORETICAL AND PRACTICAL ASPECTS REGARDING AVIATION ARMY MANAGEMENT

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Abstract: *Open architecture of multi-purpose aircraft to provide the possibility of further upgrading, flying qualities and maneuvering. The realization of the modular avionics architecture enables them to be replaced (block, module, equipment) with some of the technical-tactical superiority.*

The design of the aircraft takes into account the realization of standardized connectors, which allow only some systems to be modernized without replacing the whole assembly.

Installing software on the onboard computer, which may be replaced by some more performance over time, improves the quality of the aircraft.

Also, the multiple points of excellence allow a very complex fire management management with the continuous upgradeability. In the following paper we present an overview of the importance of military aviation in the way of thinking about the arming variants and their effectiveness.

Keywords: *decision, power of fire, air supremacy, maximum effectiveness*

1. INTRODUCTION

Taking into account the conditions of the modern struggle: high speed, very short decision-making time in the air battle, the pilot being required to perform all the operations necessary to ensure the flight and the mission (navigator, pilot, shooter) - the pilot is highly requested in the fight it is necessary to create such a weapon that the pilot's preoccupation for using it during the air strike is minimal - thus, the efficiency and automation of the on-board weaponry.

Due to the very high velocity of hunting planes, the clearance distance from the target must be high and the opening distance of the fire even greater, so that the precision of the sighting device must be good and at great distances.

Also, the effectiveness of the weapon is appropriate to the firing distance.

Air combat is a form of aerial operations between hunting, hunting-bombing, isolated or formative airplanes for mutual destruction. Success in air combat is accomplished by skillfully combining maneuver with fire.

Air combat consists of a series of judiciously organized maneuvers and precise and effective fire on the attacking aircraft with on-board means of calculation, which directly leads to the destruction of the enemy [1].

2. THE THEORETICAL ASPECTS OF THE AVIATION ARMAMENT

Artillery weapons are complemented by reactive weapons. These two armament categories complement one another.

If reactive armaments have advantages such as: high fire power, high firing distance, high precision (the guided one), etc.

It also has the disadvantage of reduced fire autonomy, which only artillery weapons can compensate for. Initial projectile speed (additional missile speed) must ensure the firing efficiency at the maximum distance for which the sights ensure the necessary corrections.

The ammunition reserve must be calculated according to the number of possible attacks. The mission of the hunting plane is:

The hunting-bombing aircraft can give 3-4 attacks requiring a 10 second fire autonomy;

• The hunting-intercept aircraft operates over its own territory and can return relatively quickly to the aerodrome by requiring a 4-5 second (for 2-3 attacks);

• The accompanying hunting jet operates on the enemy territory, requiring a fire autonomy of about 20 seconds;

Fire control must be mechanized, electrified and even automated.

To provide the required fire power, the weapon is distributed about 6-12% of the aircraft's weight (less ammunition or missiles).

Its location is good at optimized points in order to reduce the effect of kickback on flight dynamics and to ensure the required fire precision.

Role fighter-bomber aviation is an important one associated character executed missions and objectives assigned importance, with the following properties:

• can search, identify and hit small and mobile objects;

• can strike, with little force, objectives of great operational-tactical importance;

• Airplane technical and tactical features allow the breakthrough of enemy air defense and surprise intrusion into hit targets;

• High speeds make it possible to execute a "hit" or blow-up of missions and hit targets other than those originally planned;

• The features of on-board weaponry (precision, low scatter and high power of destruction) allow large targets to be disposed of by striking vital points;

• can act successfully on support missions across the entire depth of the opponent's devices [1,2,3].

3. POTENTIAL VARIATIONS AND POSSIBLE MISSIONS FOR F-16 BLOCK 15 MLU

The aircraft F-16 Block 15 MLU can access among other weapons:

- Air-to-air missiles (AAM):
  - AIM-9 L/I Sidewinder;
  - AIM-120 AMRAAM.
- Air-ground rockets (AGM):
  - AGM-65 Maverick;
- Unreacted reactive weaponry:
  - CRV7 2,75.
- Unruly Bombs:
  - MK 82 & 84;
  - MK 82 ”SNAKEYE”;
  - BDU 33.
- Bombs directed:
  - GBU-12 Paveway II;
  - GBU-31 Join Direct Attack Munition (JDAM);

- GBU-49 Dual Mode Laser/GPS.
- Electronic Warfare Pod:
- MJU-11 CHAFF/FLARE Magazine;
- MJU-12 FLARE Magazine.
- 20mm ammunition:
- 20mm (TP) training munitions;
- 20 mm incendiary ammunition (HEI).
- Additional fuel tanks.

F-16 Block 15 MLU is the variant with major changes to variants earlier, incorporating color screens, a new electronic warfare package, advanced avionics and advanced weapons [3,4,5].

Air combat operations is a form of air between fighter aircraft, fighter-bomber, isolated or in formation with the aim of mutual destruction.

Success in air combat is accomplished by skillfully combining maneuver with fire.

Air combat consists of a series of judiciously organized maneuvers and precise and effective fire on the attacking aircraft with on-board means of calculation, which directly leads to the destruction of the enemy.

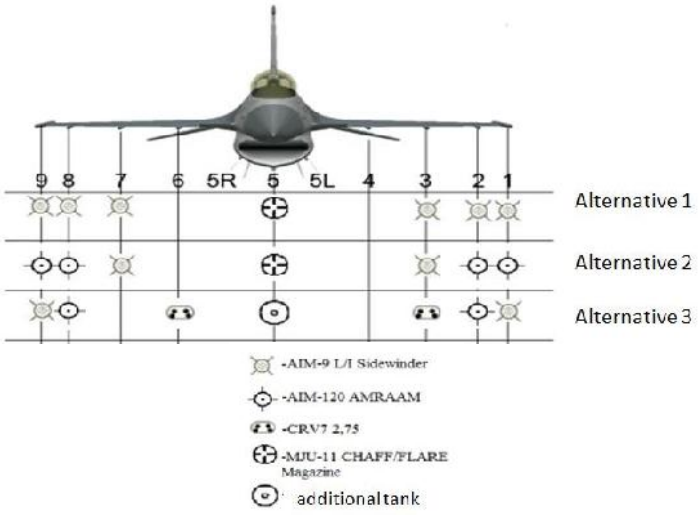

FIG. 1 Arming variants for the Air Force mission [5]

In a combat scenario to maintain air supremacy, I chose to create three different arming variants for the F-16 Block 15 MLU multi-jet airplane in which it carries an isolated aerial combat mission, see Figure 1.

For the second embodiment the arms have chosen to use six air-to-air missile AIM-9L passive infrared guided as its temperature detected by the enemy. It is extremely effective in the near-flight air strike with a short range of action.

As well as missile defense and radar guided enemy ifrared I chose to use container MJU-11 electronic warfare. The second arming version consists of 4 missiles AIM-120 AMRAAM and 2 AIM-9L.

AMRAAM is a medium range rocket using its own active radar detector for target detection while Sidewinder is a short-range missile but extremely efficient for near-flight combat.

The countermeasure used is the MJU-11 electronic warhead.

The last armament designed for air combat consists of 4 air-to-air missiles: 2 AIM-9L and 2 AIM-120 along with non-CRV 7 reactive missiles mounted on the SUU-5003.

Although the CRV 7 is designed to hit terrestrial targets, it has also proven to be very useful in air combat in the event the pilot no longer has any directed missile.

For greater flight autonomy I chose to attach a 1135 liters tank [3,4,5].

4. MAXIMUM EFFICACY

The maximum efficacy in the conditions of the modern battlefield (E) is defined as the sum of all the proposed targets ($\sum_{i=1}^{n} n_i$) to destroy their share of destruction (θ_i), relative to the number of aircrfft exits ($\sum_{j=1}^{n} i_j$) multiplied by the number of aircrafts on the way out (M).

$$E = \frac{\sum_{i=1}^{n} n_i + \theta_i}{\sum_{j=1}^{n} i_j \bullet M} \quad \text{were } \theta_i = \frac{\sum_{k=1}^{n} p_k}{N} \quad \text{and } \sum_{k=1}^{n} p_k \text{ is the amount of hit / target to destroy it,}$$

N- the number of targets;

Example:

We have 3 targets (a bridge, a warehouse, a device), 12 planes, programmed in 3 exits of 4 planes.

$$E = \frac{\sum_{i=1}^{n} n_i + \theta_i}{\sum_{j=1}^{n} i_j \bullet M} = \frac{7}{12} = 0{,}58 = 58\%, \qquad \theta_i = \frac{3+4+5}{3} = \frac{12}{3} = 4.$$

Efficiency of 58% is achieved in the condition that in order to destroy the first target it takes 3 hits, to destroy the second target it takes 4 blows and to destroy the third target it takes 5 strokes.

Efficiency is defined as achieving the mission goal using superior sensors and diversified weaponry in the ratio of the minimum number of strokes, with precise strokes to reach the target with zero losses.

5. CONCLUSIONS

• F-16 equipment is performing, diversified, and flexible, with 9 + 2 crack points on which rockets, bombs, specialized containers and additional tanks can be caught.

• Conquering and maintaining air supremacy is the basic mission that provides initiative and freedom of action for all categories of army forces. Air supremacy can be general, zonal, throughout its temporary conflict. The main targets to be hit are: airplanes and aerodromes; deposits that provide aviation resources; aerospace and fuel industry - lubricants; command and control centers and communications.

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CONSIDERATIONS ON HEAT TREATMENTS OF MARTENSITIC STAINLESS STEELS

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Abstract: *In the paper some considerations are made on stainless steel alloyed with chromium and average carbon content. These steels are used in heat-treated condition by tempering and returning. The properties obtained are influenced by the regime applied to the final treatment (tempering and recovery) and the technological parameters; at the same time changes in the metallographic structure are also observed. On the specimens of the material in the state of delivery were successively made the technological operations of annealing, tempering, returning with the parameters described in the paper. Then the specimens thus performed were subjected to tests on some mechanical and structural characteristics respectively. Thus, the correlations between the thermal treatment parameters, the metallographic aspect and the mechanical properties were revealed.*

Keywords: *martensitic stainless steels, heat treatments*

1. INTRODUCTION

Steels acquire their stainless steel property by high chromium content. Thus, in stainless steel, chromium percentages range from 10 to 20%. To improve some qualities related to increased corrosion resistance, low or high temperatures are added to the chemical composition of molybdenum and especially nickel [2, 3, 4].

The chromium-alloyed stainless steels have predominantly ferritic structure, and those chromium and nickel alloyed, the austenitic structure [5].

To obtain high hardness, the carbon content is increased to 0.3 ... 1.0% in chromium-precursor alloys. Chromium steels are subjected to final thermal treatments and are designed for the manufacture of bearings (rings, balls, rollers) working in corrosive environments, and high wear resistant tools and tools (knives, cutting tools, punches, tools surgery) [4, 6].

Thermal treatment parameters are used for TTT (for isothermal refrigerant transformations) and TRC (continuous coil). In 1 and 2 there are TTT diagrams for stainless steel with 0.4% C and 13% Cr, and Figures 3 and 4 for the same quality steel TRC diagrams.

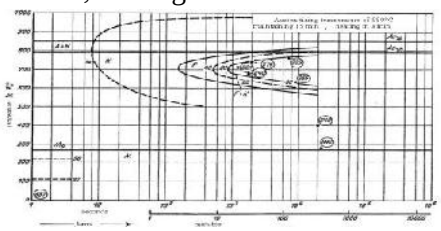

FIG. 1. TTT Diagram for Austenitizing temperature of 980°C [1]

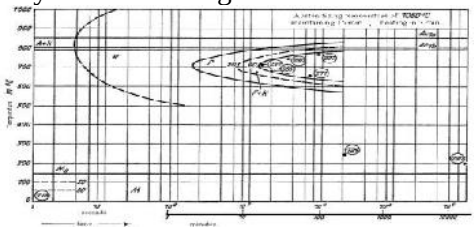

FIG.2. TTT Diagram for austenitizing temperature of 1050°C [1]

From these diagrams we find the following [1]:

- increasing the austenitizing temperature from 980 to 1080 ° C results in:
- lowering the temperature of critical point Ms by more than 100 ° C;
- precipitation of chromium carbides takes place at a higher speed.

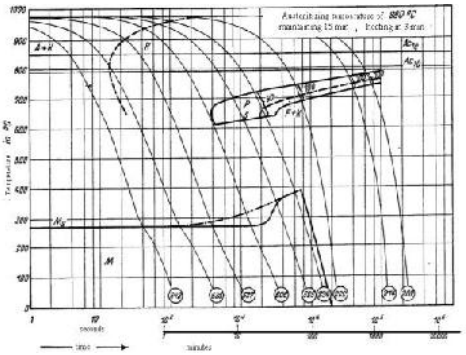

FIG. 3. TRC diagram for austenitizing temperature of 980°C [1]

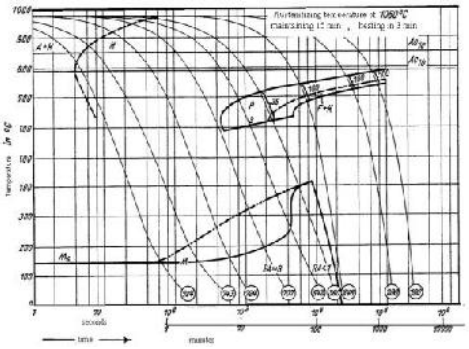

FIG. 4. TRC chart for austenitizing temperature of 1050°C [1]

TRC charts are used to study the kinetics of transformations to continuous cooling, encountered during tempering, normalization, annealing. And under these conditions the austenitizing temperature influences the thermal parameters as follows: increasing the austenitizing temperature decreases the Ms temperature by approx. 130 ° C and speeds up the precipitation of carbides.

The austenitizing temperature also influences sensitively the hardness of the quality products as in Figure 5 and 6.

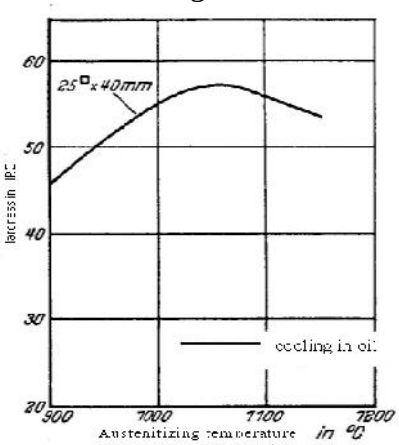

FIG. 5. Influence of austenitizing temperature on hardness after hardening [1]

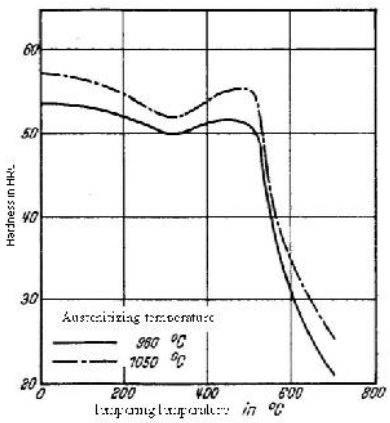

FIG. 6. Influence of austenitizing and tempering temperature on hardness [1]

The maximum hardness is achieved by tempering from approx. 1050°C. Lower temperatures result in lower hardness due to the dissolution of a smaller amount of carbon in the matrix. Increasing the temperature above 1050°C is not recommended due to increased granulation.

The return gives the final mechanical characteristics of the products, so the attention must be given to these operations. The operating temperature is selected at subcritical values depending on practical requirements.

Figure 6 describes the evolution of hardness according to temperature; generally the temperature increase results in a decrease in hardness. In the present case there is an abnormality at temperatures between 400 ... 500°C when the hardness increases as a result of the transformation of the residual austenite and precipitation of carbides.

2. EXPERIMENTAL ATTEMPTS

For the experimental study of martensitic stainless steels, steel 40Cr130 was chosen, the chemical composition of which is shown in Table 1, and the critical transformation temperatures in Table 2.

Table 1. Chemical composition of 40Cr130 steel.

The steel brand	Chemical composition [%]						
	C	Si	Mn	P	S	Cr	Ni
40Cr130	0,45	0,42	0,48	0,022	0,0010	13,21	0,23

Table 2. Critical points

The steel brand	Ac_1 [°C]	Ac_3 [°C]	The temperature of the martensitic critical point Ms, [°C]	
			Austenitization at 980°C	Austenitization at 1050°C
40Cr130	790	850	270	145

From this steel were made specimens for thermal treatments and measurement of mechanical characteristics.

For hardness and structures were used cylindrical samples with Φ20 × 15mm, and for resilience prismatic samples with U-shaped notch, according to the rules in force.

Thermal treatments and practical results are presented in the tables 3 - 5.

Table 3. Thermal treatment of annealing

The steel brand	Temperature [°C]	Time [h]	Cooling mode	Hardness HBW	Resilience KCU [J/cm^2]
40Cr130	770		Oven at 600 ° C, then cooling in air	198	60

On the anneling samples as in the above table, final heat treatment and recovery treatments were applied (Table 4).

Table 4. Heat treatment of hardening

The steel brand	Temperature [°C]	Duration of maintenance [h]	Cooling mode	Hardness HBW	Resilience KCU [J/cm^2]
40Cr130	1050	1,5	ulei	447	2,2

Table 5. Thermal treatments for recovery

The steel brand	Temperature [°C]	Duration of maintenance	Cooling mode	Hardness HBW	Resilience KCU [J/cm^2]
40Cr130	600	1h 45 min	oil	285	8,4
	650	1h 45 min	oil	202	16
	700	1h 45 min	oil	229	18
	750	1h 45 min	oil	219	46

From the values obtained and presented we find a reasonable correlation between hardness and resilience. The hardness obtained by hardening diminishes by increasing the return temperature, increasing resilience accordingly.

It is mentioned that the return temperatures were chosen at higher temperatures than the maximum hardness threshold (Figure 6) in order to obtain an average set of hardness-resilient characteristics.

Thermal treatment parameters and cooling conditions also influence metallographic structures, as in Figures 7-10.

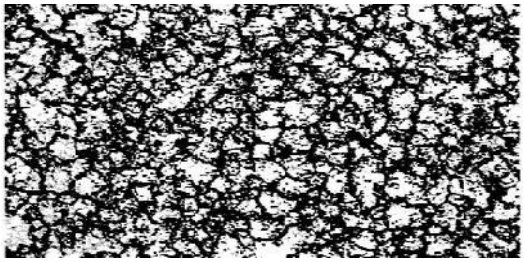

FIG. 7. Steel 40Cr130 in reworked state. Royal water attack; 500: 1[1]

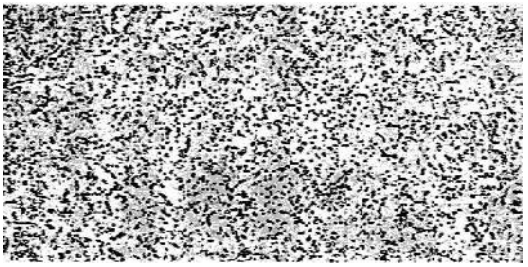

FIG. 8. Oil 40Cr130 in oil at 1050°C. Royal water attack; 1000: 1[1]

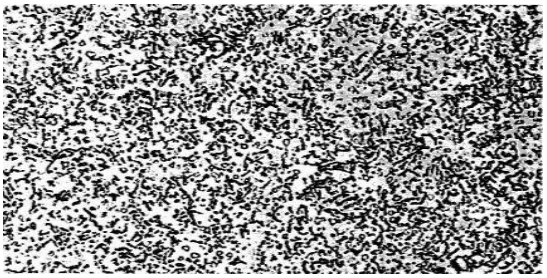

FIG. 9. Steel 40Cr130 after hardening and return to 600 ° C. Royal water attack; 1000: 1[1]

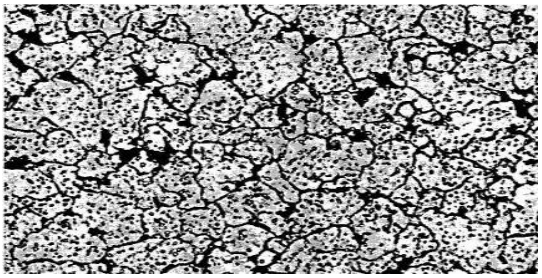

FIG. 10. Steel 40Cr130 after hardening and return to 750°C. Royal water attack; 1000: 1[1]

The annealed structure is composed of carbides and pearlite. After hardening in the structure, martensite (matrix) and non-insulated chromium carbides were formed during heating.

The return leads to detensioning, secondary carbide precipitation, and in the structure is seen the return martensite and small islands of perlite.

CONCLUSIONS

- Chrome alloyed stainless steel undergoes austenitic transformation by heating at temperatures above 800 ° C. This is also proven by obtaining high hardness by hardening, the structure being martensitic; this being the result of allotropic transformation;
- Carbon content of approx. 0.4% binds much of the chromium in the form of carbides, as well as the large amount of precipitated phases. The poorer matrix in chromium undergoes austenitic transformation;
- Recovery at temperatures above 600 ° C and higher, causes a significant decrease in metallic hardness; the processes taking place in the alloy are the following:
  - Calming martensiety →martensita de revenire;
  - Calming martenita → pearl (partial);
  - Secondary chromium carbide precipitation, etc.

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COMPARATIVE STUDY ON THE EFFICIENCY OF THE SURFACE HEAT TREATMENT WITH CONCENTRATED ENERGY SOURCES

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Abstract: *The concentrated energy sources taken into study were that of the laser and the electron beam, which was applied to surfaces with substrates of improved steel. The layers thus obtained were subject to tests of hardness, microstructure, wear resistance. As a result of experimental attempts and final tests, it has been found that for the small parts it is also possible to consider these processes to replace the deposition of harder layers, more expensive. Superficial hardening with laser and electron beam can be technically and economically efficient with appreciable practical results and high productivity. Using laser in this purpose has proven to be more efficient than the electron beam. And in the case of superficial hardening with concentrated energy sources, alloyed steels give superior results to carbon.*

Keywords: *superficial hardening, laser, electron beam*

1. INTRODUCTION

1.1. Laser surface treatment

The laser generator produces a laser beam that focuses on heating surfaces [2]. Depending on the physical properties of the surfaces to be treated and the characteristics of the laser beam, it is possible to achieve the surface treatment in two ways [3,6]:

- by solid phase transformations;
- by liquid phase transformations (vitrification) when the power densities are greater than 12…13 Kw / cm^2 .

For both cases it is not necessary to use external cooling, the heat dissipating quickly in the mass of the piece and respectively in the surrounding environment [4,7]. The laser heating cycle has a sharp form, with a sharp slope for both heating and cooling [8].

1.2. Electron beam surface treatment

The electron as the elementary particle is also characterized by the fact that it holds the mass. If it prints a speed, it also shows energy. If an electron beam is oriented towards a metal surface, the kinetic energy turns into thermal energy, heating the material to be processed [1].

The electron beam produced by a specific installation (the main subassembly being the electron gun) is focused on the piece to be treated . Both the piece and the electron beam space transit are situated in a vacuum space.

And when using the electron beam, the hardening of the surface can be done with and without the melting of the target as follows:

- With power densities of 10^3 .. 10^4 w / cm^2 and action duration of 1 ... 3 seconds, the heating of the material takes place in the solid state domain [5];

-With power densities of 10^6 .. 10^7 w / cm^2 and action duration of 10^{-2} ... 10^{-1} seconds, after the electron beam heat treatment, the metal is melting, followed by a extremely rapid cooling along with durification.

2. EXPERIMENTAL ATTEMPTS

Experimental attempts were aimed at determining the comparative of superficial treatments efficiency using two concentrated energy sources (heating with laser and electron beam). The tests were performed on two types of improvement steels, the chemical composition of which is shown in Table 1.

Table1. Chemical composition

No.	Mark of steel	Chemical composition in %							
		C	Cr	Ni	Mo	Si	Mn	S	P
1	OLC45	0,467	0,165	0,141	0,035	0,240	0,650	0,019	0,017
2	41Cr4	0,444	1,00	0,029	0,022	0,207	0,740	0,011	0,077

The specimens necessary for carrying out volumical and superficial thermal treatments, specimens corresponding to the hardness tests, microhardness, metallographic structures, wear resistance, were made from these steels. Initially, the samples were subjected to the thermal improvement treatment, as shown in Table 2.

Table 2. Volumical heat treatment

No.	Mark of steel	Nitrural hardness	Hardening			Annealing		
			Temperature [^{0}C]	Cooling medium	Hardness [HRC]	Temperature [°C]	Time [h]	Hardness [HRC]
1	OLC45	23,5	850	water	60,5	550	1	33,8
2	41Cr4	24,2	850	oil	54,5	550	1	37,5

Concentrated energy sources were used to superficially heat treatment of samples which were thermally treated as above. The following are the tehnological processes for durification of the external layers by the above mentioned processes.

2.1. Superficial laser hardening

A CO2 laser pulse generator was used. A working regime has been chosen, so that only transformations in a solid state occur in the superficial layer. Table 3 shows the working conditions for the superficial hardening of samples from the two steels.

Table 3. The working parameteres at superficial hardening with laser

Alloyd steels	P [w]	v [mm/s]	d_{spot} [mm]	D_{beam} [mm]	Number of passage	Medium microhardness
OLC45	700	7,5	3,5	30	5	484
41Cr4						535

Superficial hardening with laser was effectuated with no cooling liquid, only with radiation and conduction.

Aspects of microstructures of superficial layers hardened with laser are shown in figures 1 and 2.

FIG.1. OLC 45 steel improved and superficial hardened (laser CO2) superficial layer +ZIT; Nital Atack 200:1

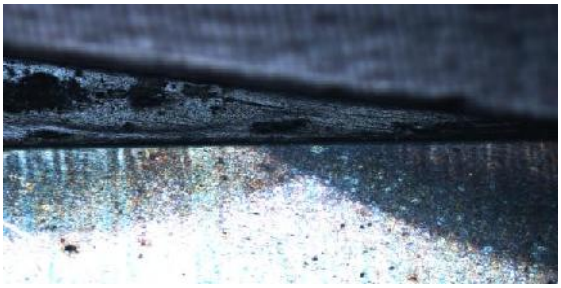

FIG.2. 41Cr4 steel improved and superficial hardened (laser CO2) superficial layer; Nital Atack 200:1

The microstructures above were chosen due to notice the influence of a passage on superficial processing.The strips were made with the distance between the spots (Fig. 1) and the partially overlapping spots (fig. 2).

2.3.Superficial hardening with electron beam

Experimental attempts have been made to work by scraping surfaces The working parameteres at superficial hardening with electron beam are shown in table 4.

Table 4. The working parameteres at superficial hardening with electron beam

U	I	v	l	Layer hardness	
				OLC45	41Cr4
60	18	140	150	675	711

Aspects of microstructures of superficial layers hardened with electron beam are shown in figures 1 and 2.

FIG.3. OLC45 improved steel and superficial hardened with elecron beam. Nital Atack 200:1

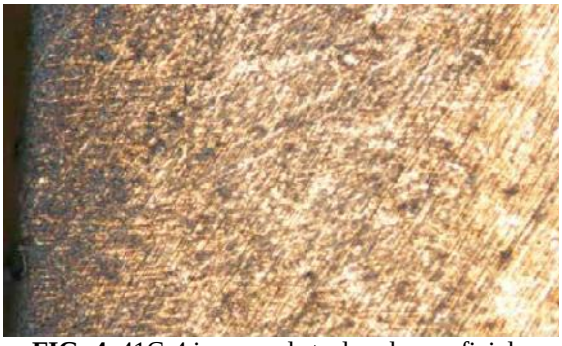

FIG. 4. 41Cr4 improved steel and superficial hardened with elecron beam. Nital Atack 200:1

The results of wear experimental attempts for samples superficial hardening

For each sample, weighing with the analytical balance was performed successively 5 to 6 times at equal time intervals (5 min); In this way, weight loss was determined after each wear cycle.

These operations were performed for each brand of steel, respectively for each heat treatment state:

- after improvement (hardening and high annealing) CR;
- after improvement followed by superficial laser hardening (CR+L);
- after improvement followed by superficial electron beam hardening (CR+FE);

The reasults of wear measurements are given in tables and diagrams below.

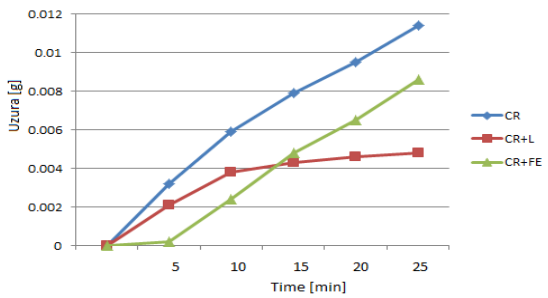

FIG. 5. The wear evolution of OLC45 steel samples treated in different mode

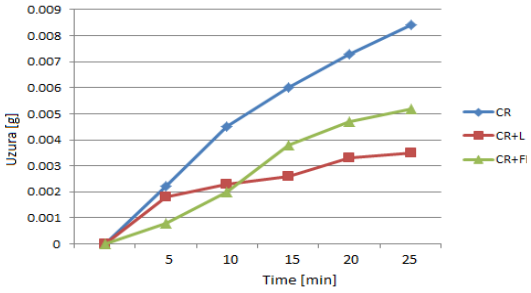

FIG. 6. The evolution of wear at 41Cr4 steel samples treated in different mode

It can be noticed that the size of wear has recorded differences, not only in different treatments but also from one material to another. From the above we can state the following:

- compared to improved condition, by applying superficial heat treatment, wear behavior significantly improves by 50% and even more;

- superficial laser thermal treatment is generally more efficient than with electron stream treatment;

- to some samples the wear was lower at the CR + FE samples, compared to CR + L samples, but only at the beginning of the wear process. Perhaps superficial hardening with electron beam also produced an outer film (very thin) by transformation from the liquid state. After the wiping of this film, the wear process has been enhanced.

- 41Cr4 Alloy improvement steel, gave superior results to OLC45 carbon improvement steel. The formation of chromium carbides as well as the martensite alloyed with this element contributed to the improvement of the wear resistance.

3. CONCLUSIONS

In addition to the usual surface treatments, it can also take into consideration the unconventional ones, namely the concentrated laser energy sources and electron stream. These processes have areas of application on small active surfaces, such as parts in the electrotechnical field and fine mechanics (cricket wheels, cams, sticks, small gears, etc.). At some points, the unconventional processes studied in this paper may become effective due to the extremely short process time and the fact that it does not require liquid medium for cooling . In improved condition, as well as through superficial hardening, whatever the process used, alloyed steels to the same carbon content, give better results.

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CALCULATION OF NOISE CONTOURS AROUND AIRPORTS

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Abstract: *This article refers to the process of generating the noise contour around airports and how noise levels can be mediated or accumulated to generate noise index values. Regardless of the source of the flight data, each aircraft movement is defined taking into account the flight path geometry and the noise emitted by the aircraft following its flight path. The contour calculation methodology recommended by European Standards involves segmenting the flight path to suit each other independently.*

Keywords: *acoustic, panels perforated, SoundFlow .*

1. INTRODUCTION

Worldwide, the overall noise level is alarmingly high. we live in a noisy society mainly due to the technological environment in which we evolved.

In order to have relevant information about the magnitude and magnitude of the impact caused by aircraft noise around airports, maps that have marked outline contours are required. A noise contour is generated by the mathematical calculation of the areas where there are noise indices and is marked by a line along which the index value is constant. The way noise is perceived at airport ground points depends on several factors, such as: type of aircraft, types of engines used by aircraft, procedures applied by them to adjust engine power, flaps and speed to air.

Through this paper I want to deal in detail with the modeling and generation of the noise contour and focus on the way of calculating the noise levels produced by individual aircraft events and how the noise levels can be mediated or accumulated to generate values of the zig-zag index at a certain point.

2. CALCULATION OF NOISE CONTOURS

Two kinds of noise contours can be matheatically calculated, depending on the need the observer:

- Contours used to generate the historical noise impact They are the result of current records of aircraft operations - movements, operational weights, flight trajectories measured on radar, etc.
- Contours used to make forecasts based on estimates of airport traffic, flight paths, and aircraft characteristics that will use the airport.

When noise contours are obtained by interpolation between index values at rectangularly spaced grid points, their accuracy depends on the choice of the grid spacing ΔG, especialy within celles where large gradients in the spatial distribution of the index cause tight curvature of the contours, (see fig. 1).

Interpolation errors are reduced by narrowing the grid spacing, but as this increases the number of grid points, the computation time is increased. Optimising a regular grid mesh involves balancing modelling accuracy and run time.

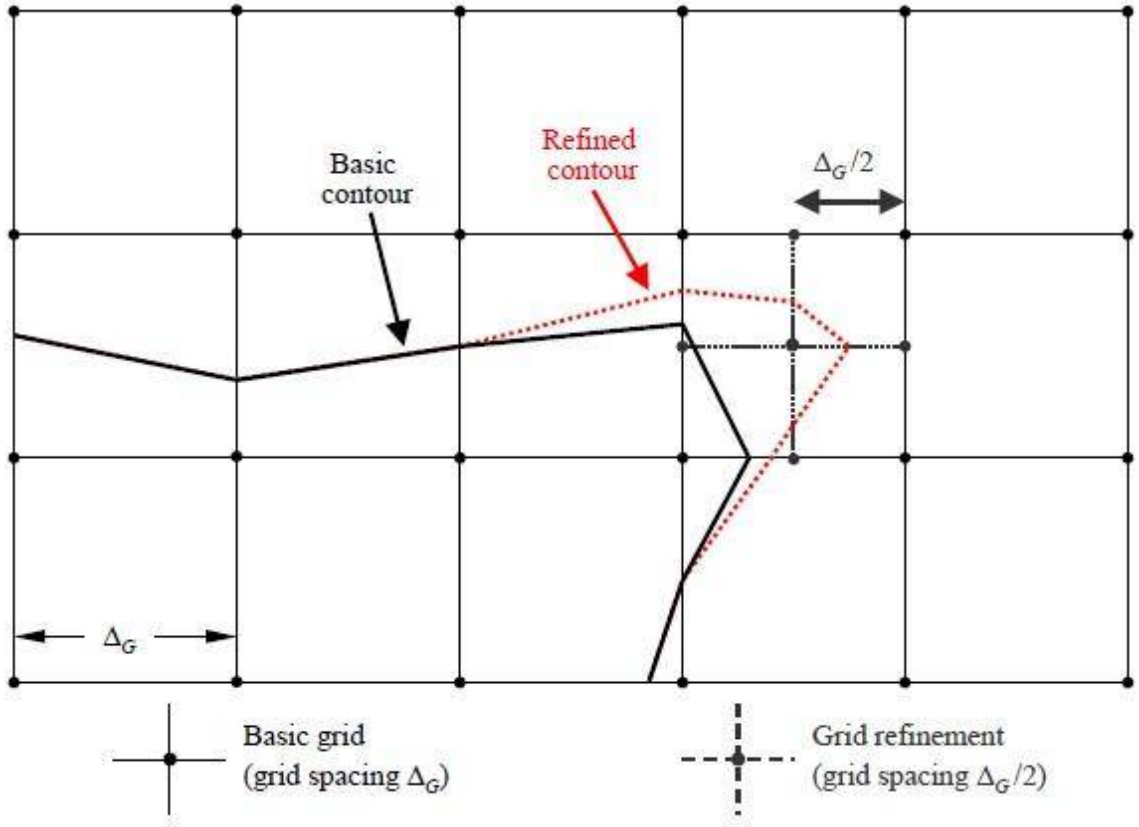

FIG. 1. Standard grid and grid refinement

A marked improvement in computing efficiency that delivers more accurate results is to use an irregular grid to refine the interpolation in critical cells. The technique, depicted in Figure 1, is to tighten the mesh locally, leaving the bulk of the grid unchanged. This is very straightforward and achieved by the following steps:

1. Define a refinement threshold difference ΔL_R for the noise index.
2. Calculate the basic grid for a spacing Δ_G.
3. Check the differences Δ_L of the index values between adiacent grid noise.
4. If there are any differences $\Delta_L > \Delta L_R$ define a new grig a spacing $\Delta_G/2$ and estimate the levels for the new nodes in the fallowing way:

IF $\Delta L \leq \Delta LR$ calculate the new value by linear interpolation from the adjacent ones.
$\Delta L > \Delta LR$ completely anew from the basic input data.

5. Repeat steps 1–4 until all differences are less than the threshold difference.
6. Estimate the contours by linear interpolation.

If the array of index values is to be aggregated with others (e.g. when calculating weighted indices by summing separate day, evening and night contours) care is required to ensure that the separate grids are identical.

2.1. Use of rotated grids

In many practical cases, the true shape of a noise contour tends to be symmetrical about a ground track. however if the direction of this track is not aligned with the calculation grid, this can cause result in an asymmetric contour shape.

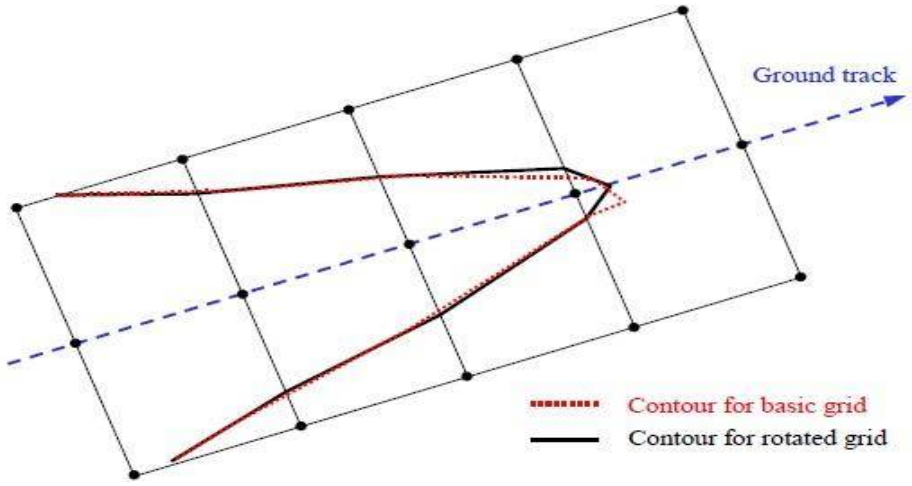

FIG. 2. Use of a rotated grid

The straightforward way to avoid this effect is to tighten the grid. However this increases computation time. A more elegant solution is to rotate the computation grid so that its direction is parallel to the main ground tracks (eg. usually parallel to the main runway). Figure 2 shows the effect of such a grid rotation on the contour shape.

2.2 Tracing of contours

A very time-efficient algorithm that eliminates the need to calculate a complete grid array of index values at the expense of a little more computational complexity is to trace the path of the contour, point by point. This option requires two basic steps to be performed and repeated (see Fig. 3):

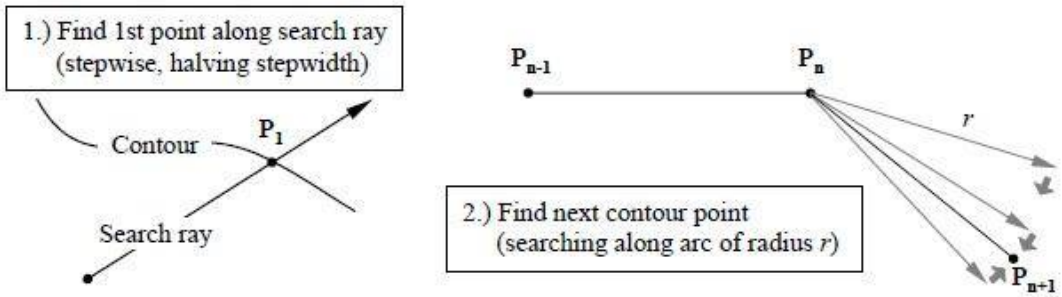

FIG. 3

- step 1 is to find a first point p_1 on the contour. this is done by calculating the noise index levels l in equidistant steps along a 'search ray' that is expected to cross the required contour of level l_c. when the contour is crossed, the difference $\delta = l_c - l$ changes sign. if this happens, the step-width along the ray is halved and the search direction is reversed. this is done until δ is smaller than a pre-defined accuracy threshold.
- step 2, which is repeated until the contour is sufficiently well defined, is to find the next point on the contour L_C - which is at a specified straight line distance r from the current point. During consecutive angular steps, index levels and differences δ are calculated at the ends of vectors describing an arc with radius r. By similarly halving and reversing the increments, this time in the directions of the vector, the next contour point is determined within a predefined accuracy.

CONCLUSIONS

The future development of air traffic involves a complex control of the noise generated by it. Diminishing exposure of the population to noise is one of the main activities required.

Noise modeling is the means by which acoustic mapping is performed in the vicinity of the airport, quantifying the exposure of the population to different levels of noise.

Also, by modeling, reduction scenarios such as changing the overhangs in the sense of distancing these colors to sensitive areas, simulating the removal of major aircraft categories.

A knowledge of population exposure influences a series of decisions on exposure reduction, such as: redistribution of air traffic at different intervals of the day, regulations on the composition of air traffic.

Airborne noise monitoring provides a database that updates in real time, helping to obtain more accurate data and a wider range of factors that impact on noise.

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ASPECTS REGARDING LIFE SAVING MILITARY PILOTS

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Abstract: *Military pilots life saving is a large and very important domain. Though being genuinely natural for human beings to save the lives of their fellows, life saving also has a economical ground. The resources that are being invested in training a pilot are quite extensive, consequently all effort should be made to secure this investment. This article will tackle only an aspect of saving the life of military pilots: the preparation for rescue.*

Keywords*: pilots' life saving, preparation, rescue*

1. INTRODUCTION

The military pilot rescue preparation is a special preparation, as it is a unique category in the training and instruction of a pilot. This preparation does not need any grades, marks or degrees of importance, as it is genuinely imperative.

The ejection or leaving the plane by parachuting, as it is in the limits of fligh safety, is imposed most of the time as the unique alternative of rescuing the pilot, in his attemps to solve a critical fligh situation, when his life is obviously threatened. The pilot's attitude towards this plane leaving procedure and also the concrete way of action are determinant conditions to life saving when it is no longer possible to continue the airplane flight.

The general cases of emergency during the flight, when an airplane must be ejected through forced parachuting, are:

– Fire on board and the impossibility to execute its timely extinction

– Shut down of the propulsion system and the impossibility of timely starting it, or the safe execution of the forced landing;

– Critical damage of the aircraft;

– Abnormal functioning of on-board installation that endangers the life or the body integrity of the crew;

– Dangerous meteorological phenomena that influence the flight, the aircraft functioning or the possibility for the pilot to maintain its position in space;

– Loss of space orientation or control of the aircraft during the execution of maneuvers and impossibility to restore them in due time;

– Serious damage of the pilot's health;

– Other situations that are specified in the aircraft flight manual [1].

In the general rescue actions, catapulting takes the lead. Alongside the adequatelogistic support, consisting of high performing equipment, knowing their features, operating mode and restrictions is imperatively imposed and is organically linked with the instruction and enhancement of a natural confidence in their effectiveness.

2. TYPES OF RESCUE PREPARATION

The types of rescue preparation for flight personnel are:

– parachute training;
– search-rescue exercise for catapulted or forced parachuted flight personnel;
– survival courses;
– training courses for new types of aircraft;
– conventions with flight personnel on knowing and using designated means of rescue;
– practical training sessions of flight personnel.

In addition to the preparation of the flight personnel, it is also importantto focus on the training of the personnel with attributions in this field: the parachuting and means of rescue instructors and the specialized technical personnel.

The purpose of the parachuting training with the flight personnel is to build the necessary skills to leave the aircraft, to understand the infuence of the air nets on the body during the stabilized descent, parachute opening, open parachute decent, observing different landmarks and safely landing the parachute.

I should remind here that the Romanian Air Force flight personnel use a Romanianbuilt parachute to execute the jumps, BG-7M. The parachute opening system is a combined one, permitting both automated and commanded opening. Consequently, the parachute has several types of functioning: automated, stabilized, commanded through simple command, commanded through double command [2].

In the following paragraphs I will present the similarities between the training parachuting with BG-7M and the catapulting process, implicitly the importance of this means of rescue preparation.

The psychological strain on which the flight personnel is subjected to when leaving the aircraft and the parachute opening moment, when the training leaps are performed, is quite similar to those that occur during the catapultion. By performing the leaps, the psychological or mental resilience increases.The mental resilience is the property of psychological processes and products to maintain for a long time the functional parameters in the conditions of disturbing factors. In a broad sense, psychological resilience represents the limit to which the individual's psyche has the capacity to respond functionally and adaptively to the prolonged demands it is subjected to [3].

Among the physical factors that influence both processes, we mention noise, vibrations, cold, heath, smoke, claustration, light, darkness.

Another similarity between the two processes, parachuting and catapulting, would be the influence of the air nets. The stabilized fall with the BG-7M training parachute, at a speed of 33-35 m/s, is quite similar to a pilot'sstabilized fall with he catapult seat, until the seat is detuned and the main parachute opens.

The opening of the training parachute is an important moment and resembles to solving some special situations during the operation of the catapult seat. During catapulting, some components may work improperly and the catapulting process may be blocked. In these cases, in order to disengage the catapult seat and open the main parachute, the pilot must be able to operate the parachute command.

The descent with an open parachute and the observation of different landmarks is an important moment in the catapulting procedure. During the parachute descent, the flight personnel observe the ground landmarks, choose the approximate landing position and execute piloting maneuvers to avoid landing obstacles.

These aspects are really important, on one hand, to generate a secure landing, and on the other hand, for the pilot's future actions after landing. From the air, the pilot observes landmarks that he will use: residence areas or human settlements, flowing waters, lakes, roads, etc.

Parachute landing is also important because the paratrooper contacts the ground at speeds that vary with the speed of wind and the position of the parachute. The landing, either by training parachute, or by rescue parachute, is performed similarly: place the parachute with the face against the wind, feet are close, make contact with the ground on both legs.

To better observe the similarities between the rescue parachutes used by the Romanian Air Forces:

– PS-29 – rescue parachute that equips or equipped some aircrafts that are no longer used: IAK-52, C-130, C-27J, An-2, An-24, An-26, An-30, L-29 [4];

– PSMR - rescue parachute that equips MiG-21 [5], see figure 1;

FIG. 1 Rescue parachute PSMR

– PSC-10 - rescue parachute that equips IAR-99 Standard and Soim [6];

– PL-70 - rescue parachute that equipped L-39 [7], see figure 2;

FIG. 2 Rescue parachute PL-70

– and training parachute BG-7M, i will further present their main features in the Table 1:

Table 1. Main features of rescue parachutes

Main features	Parachute type				
	BG-7M	PS-29	PSMR	PSC-10	PL-70
Cannopy surface (square meters)	94	57	54	56	50
Shape	semi-spherical	semi-spherical	semi-spherical	aero conical	triangle
Nr. of suspante lines	36	28	28	20	24
Type of material	kapron	kapron	kapron	nylon	canvas
Nr. Slots	3	3	-	2 net pannels	-
Landing speed(m/s)	4,5	6	6	6,5	6,5

After a safe landing, the pilot will perform an objective evaluation of the real situation he is in, and depending on which he will take some future actions. The analysis of the situation will be made taking into account:

– health state;
– if the pilot is alone or part of a crew;
– day time;
– nature of landing territory (relief, vegetation, etc) and meteorological conditions;
– coordinates of landing position and identification of landmarks;
– distance from communication routes, residence areas, water flows, etc.;
– material means and level of training to move into hard to reach land and survival;
– distance to air base;
– visibility conditions for search and rescue;
– other factors that may influence the pilot's actions.

Following the analysis, the pilot may choose one of the alternatives:

– to wait at the accident scene until the arrival of the rescue crew;

– to leave the accident scene and head towards the nearest residence area or other route of communication;

– in case of a crew, the injured pilot that cannot be transported remains at the accident scene and the other will leave to look for help and assistance;

– any other action that derives from the created situation.

These actions that need to be performed by flight personnel, are also included in other types of training: search and rescue exercises of ejactioned or forced parachuted flight personnel and survival courses.

During search and rescue exercises, both survivor's/ survivors' and search and rescue crew preparation are carried out: pilots, onboard mechanic, paramedic, search and rescue and evacuation operators. The search and rescue crew will do their best to recover the pilot, that will have to work efficiently and timely with it.

Search and rescue exercises can be carried out in conjunction with other survival courses or exercises.

Survival courses tackle two aspects of survival: survival in friendly terrain and survival in enemy terrain. The survival in enemy terrain is actually the ABC. During this training, the survivor's main skills are acquired: how to build the shelter, how to obtain water, food, how to make the fire, how to move, how to choose the extraction point, how to signal his position in order to be found and recovered by the search and rescue crew.

Survival in enemy terrain is based on the acquired skills and knowledge, but also on some other, more specific aspects. We discuss here about S.E.R.E concept (Survive / Eviction, Evasion / Rezistance / Extraction).

We need to give special attention to the survival on water/sea, a special training that is designed for flight personnel that fly over large water spans. This training resumes the knowledge of the aircraft on board rescue equipment used by the flight personnel as well as how to use it. Also, increased attention needs to be given to the particularities of survival in water environment, as well as the extraction procedures used by the search and rescue crew.

The other three types of preparation, training courses for new types of aircraft,conventions with flight personnel on knowing and using designated means of rescue, practical training sessions of flight personnel are carried out at a predetermined interval and mainly represent small stages in completing the types of preparation or training mentioned above.

3. CONCLUSIONS

This article emphasizes a certain aspect related to military pilots' rescue, namely the rescue preparation. In Romanian Air Force this rescue preparation is performed responsibly, professionally, by responsible personnel, even if in certain periods, due to material shortages, it could not be performed at the required standards.

The execution of training parachuting, with Air Force Academy flight students of and with flight personnel operating aircraft onboard rescue parachutes, participating to survival courses on water/sea and S.E.R.E.(Survive / Eviction, Evasion / Rezistance / Extraction) and to annual search-rescue and survival exercises, has the final purpose to acquire the necessary skills to properly use the military aircraft onboard rescue equipment, increasing the confidence in this equipment to properly and correctly use them when urgently needed. This preparation and training may certainly be improved, as the main objective is flight personnel life saving.

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COANDA EFFECT ON THE FLOWS THROUGH EJECTORS AND CHANNELS

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Abstract: *Coanda effect consists of the tendency of a jet to adhere to and to flow around nearby solid boundaries. This general class of phenomena, which may be observed in both liquid and gaseous jets, are known as the Coanda effect.*

In this paper, interest in the detailed behavior of an existing Coandă ejector model is taken, used in propulsion systems. The goal is to investigate the influence of various geometric parameters and pressure ratios on the Coandă ejector performance.

The application of the Coandă effect to the directional control of a jet is also presented. Deviation of the thrust force by direct flow can be achieved by using the Coanda effect to change the angle of the primary jet engine exhaust nozzle.

Since single jet flows or multi-jet flows are extensively applied in conjunction with the Coandă surface, as confined or free jet flows, in the last part of the paper, further insight into complexities involving issues such as the variety of flow structure and the related bifurcation and flow instabilities are provided.

Thus, the conditions and the limits within which one can benefit from the advantages of Coandă-type flows are determined.

Keywords: *Coandă effect, Coandă ejector, jet deflection, stationary bifurcation, CFD*

1. INTRODUCTION

The phenomenon to adhering of a fluid jet to a convex solid surface, known as the Coandă effect, has applications in aviation and many others in industry, in particular to obtain nozzles with high thrust augmentation and to increase the maximum lift coefficient of a wing.

In recent years, due to the development of computing techniques, many numerical experiments have been carried out which have led to a more thorough investigation of this phenomenon and to the optimization of configurations that use this phenomenon to increase their performance.

Sometimes the Coandă effect should be avoided, such as for an air-conditioned room, because the mixing of the injected air with the air of the room is not optimal.

To define the conditions and the limits to which it is advantageous to use the Coandă effect, studies and experiments are needed to determine its influence with respect to the geometrical and flow parameters.

The Coandă ejector is an axisymmetric device that uses the injected primary flow on the inner curved surface and entrains the secondary flow (Fig. 1).

The main purpose of the Coandă ejector is to provide a high ratio of the induced mass flow rate to the primary mass flow rate.

A high pressure tank provides a primary flow, which will follow the curved contour of the ejector after the sonic throat, due to Coandă effect. The expansion or compression waves are created depending on the pressure at the outlet section of the primary nozzle and, as a result, a turbulent mixing zone is developed. The effect of various factors, such as the pressure ratio, primary nozzle and ejector configurations on the system performance is evaluated based on the performance parameters. The mixing layer growth plays a major role in optimizing the performance of the Coanda ejector as it decides the ratio of secondary mass flow rate to primary mass flow rate and the mixing length.

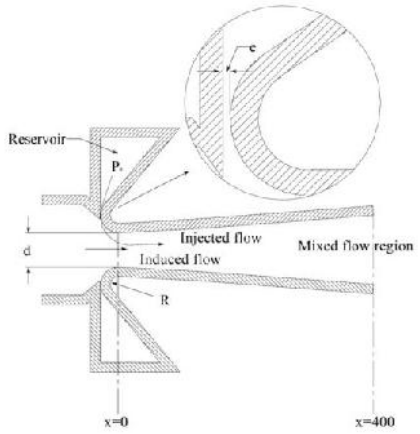


FIG 1. Schematic of the Coanda ejector

There are several works [1]-[5] investigating the mechanism through which the secondary flow is induced in the ejector. In this paper the authors study the various flow patterns inside the Coandă ejector and the effect of various design parameters on the mass flow rate of the induced flow numerically.

In the last part of the paper, further insight into complexities involving issues such as the variety of flow structure and the related bifurcation and flow instabilities are provided for the jet flowing to a wall by Coandă effect for several geometrical configurations.

Using the Ansys Fluent code, in this paper internal flows are analyzed, in order to determine the influence, advantages and limitations of the Coandă effect.

2. MATHEMATICAL MODEL

A. Dimensionless Forma of Fluid Transport Equation

Dimensionless quantities are universal, and independent of operating variables, such as fluid, geometric scale, operating pressure, etc. Therefore, all parameters in the research are converted to the dimensionless terms.

The fluid transport equations such as the mass (continuity), momentum, and energy conservation equations are presented in this section.

The mass conservation equation, or continuity equation, for the compressible flow is

$$\partial\rho/\partial t + \bar{\nabla}\cdot(\rho\bar{v}) = 0 \tag{1}$$

where: ρ = fluid density (kg/m^3), t = time (s), v = fluid velocity in a vector notation (m/s), $\bar{\nabla}$ = gradient operator.

The characteristic density and velocity are introduced to transform this equation to the dimensionless form. We define: ρ_c = characteristic (an inlet) density of the fluid (kg/m^3), U = characteristic (an inlet) velocity of the fluid (m/s), t_c = characteristic time (s), and L = characteristic length = an inlet diameter of ejector (m).

Then each term is converted to dimensionless form by multiplying and dividing each term by their characteristic parameters, and then rearranging the equation. Hence, the dimensionless form of this equation is presented in the following equation

$$\partial\tilde{\rho}/\partial\tilde{t} + \tilde{\nabla}\cdot(\tilde{\rho}\tilde{v}) = 0 \tag{2}$$

Momentum conservation for compressible flow in dimensional form is [6]:

$$\begin{aligned}\rho\frac{\partial}{\partial t}(\rho\bar{v}) + \overline{\nabla}\cdot(\rho\bar{v}\bar{v}) &= -\overline{\nabla}P_{dyn} + \mu\nabla^2\bar{v} + 2\overline{\nabla}\mu\cdot\overline{\nabla}\bar{v} \\ &+ \overline{\nabla}\mu\times(\overline{\nabla}\times\bar{v}) + \frac{1}{3}\mu\overline{\nabla}(\overline{\nabla}\cdot\bar{v}) - \frac{2}{3}(\overline{\nabla}\cdot\bar{v})\overline{\nabla}\mu\end{aligned} \tag{3}$$

where: D/Dt = material derivative, P_{dyn} = dynamic pressure (Pa), μ = fluid viscosity ($N\cdot m$), ∇^2 = Laplacian operator.

Since the geometrical configuration of the ejector is axisymmetric, the continuity equation will be used in axisymmetric coordinates

$$\frac{\partial\rho}{\partial t} + \frac{\partial}{\partial x}(\rho\bar{v}_x) + \frac{\partial}{\partial r}(\rho\bar{v}_r) + \frac{\rho\bar{v}_r}{r} = 0 \tag{4}$$

and the mass conservation equation in axisymmetric case is

$$\begin{aligned}\frac{\partial}{\partial t}(\rho\bar{v}_x) + \frac{1}{r}\frac{\partial}{\partial x}(r\rho\bar{v}_x\bar{v}_x) + \frac{1}{r}\frac{\partial}{\partial r}(r\rho\bar{v}_t\bar{v}_x) &= -\frac{\partial P}{\partial x} \\ &+ \frac{1}{r}\frac{\partial}{\partial x}\left[r\mu\left(2\frac{\partial\bar{v}_x}{\partial x} - \frac{2}{3}(\overline{\nabla}\cdot\bar{v})\right)\right] + \frac{1}{r}\frac{\partial}{\partial r}\left[r\mu\left(\frac{\partial\bar{v}_x}{\partial r} + \frac{\partial\bar{v}_r}{\partial x}\right)\right]\end{aligned} \tag{5}$$

B. The Energy Equation

In compressible fluid, the energy equation is used corporately with the transported equations to calculate fluid properties.

The governing energy equation is presented (Fluent, 2001):

$$\frac{\partial}{\partial t}(\rho E) + \overline{\nabla}\cdot\left[\bar{v}(\rho E + P)\right] = \overline{\nabla}\cdot\left[k_{eff}\overline{\nabla}T - \sum_j h_j\bar{J}_j + (\bar{\bar{\tau}}_{eff}\bar{v})\right] + S_h \tag{6}$$

where: E = internal energy (J), k_{eff} = effective conductivity (J/K), ∇T = total temperature difference (K), h_j = sensible enthalpy of species j (J), $\bar{J}_j$ = diffusion flux of species j, $\bar{\bar{\tau}}_{eff}$ = effective viscous dissipation ((Js)/m), and S_h = volumetric heat sources (J).

The equations can be spatially averaged to decrease computational cost, yet the averaging process yields a system with more unknowns than equations.

Hence, the unclosed system requires a model (e.g., turbulence, or subgrid scale) to make the problem well posed. Such models are used in RANS and LES approaches to CFD.

All the equations stated above are used to calculate fluid properties in CFD code, Fluent.

C. The Turbulence Modeling: SST Model Formulation

The basic idea behind the SST model is to retain the robust and accurate formulation of the Wilcox $k-\omega$ model in the near wall region, and to take advantage of the free stream independence of the $k-\varepsilon$ model in the outer part of the boundary layer.

In order to achieve this aim, the $k-\varepsilon$ model is transformed into a $k-\omega$ formulation by means a function that is one in the near wall region and zero away from the surface. The final form is

$$\frac{\partial}{\partial x_j}\left(u_j k\right)=\frac{\partial}{\partial x_j}\left[\left(\nu+\sigma_{k1}\nu_t\right)\frac{\partial k}{\partial x_j}\right]+P_k-Y_k \tag{7}$$

$$\frac{\partial}{\partial x_j}\left(u_j \omega\right)=\frac{\partial}{\partial x_j}\left[\left(\nu+\sigma_{\omega}\nu_t\right)\frac{\partial \omega}{\partial x_j}\right]+\gamma P_{\omega}-Y_{\omega}+$$
$$2\left(1-F_1\right)\sigma_{\omega 1}\frac{\nu_t}{k}\frac{\partial k}{\partial x_j}\frac{\partial \omega}{\partial x_j}$$

Model constants and implementation are presented in detail in [7], [8].

3. NUMERICAL MODEL

In the CFD study, the jet ejector model geometry matched the experimental apparatus. A commercial CFD code FLUENT with a preprocessor, GAMBIT is used to conduct the numerical analysis on the Coandă ejector. An axisymmetric Coandă ejector model is created with a structured and unstructured grid system with quadrilateral cells. The grid size was optimized to be small enough to ensure that the CFD flow results were virtually independent of size, but large enough to ensure the model run efficiently at an acceptable speed [9].

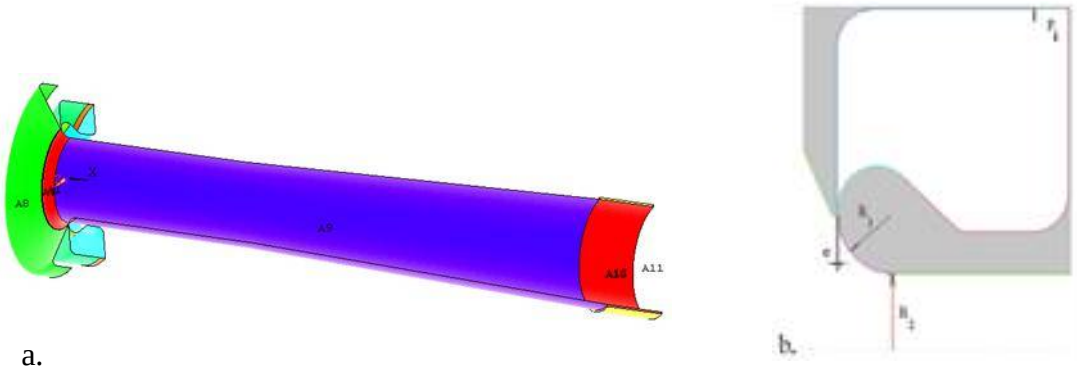
A non-uniform grid was selected because it provided the greatest control of the number of cells and their localized density. For optimal meshing, the grid density increased near the wall and in areas where flow gradients were steep.

This is accomplished by applying weighting factors to increase the grid density at these areas

The used mesh is divided in structured grid near the wall and unstructured grid otherwise. The y^+ values of the wall-next grid points were between 0.2 and 1, and the Δx^+ values were between 50 and 300.

The numerically results was obtained for a total pressure value of 5 bar, imposed at the reservoir inlet. The computational domain includes the adjacent regions of the ejector with the physical opening boundaries condition.

FLUENT is a density based finite volume computational fluid dynamics code which solves the three-dimensional or axisymmetric compressible Navier-Stokes equations in the desired domain. The flow is considered to be steady.



a.

FIG. 2. 3-D geometric Coandă ejector configuration (a.) and detail of the throat gap and Coandă surface – one primary jet (b.)

The following geometrical configurations are used (Fig. 2): $e_1 = 0.25$ mm, $e_2 = 0.40$ mm; $R_1 = 7.5$ mm and $R_2 = 37.5$ mm .

4. RESULTS AND DISCUSSIONS

The Mach number contours at the ejector throat are plotted in Fig. 3, and the pathlines patterns can be shown in Fig. 4, for this axisymmetric model of the standard Coandă ejector. From these figures it can be observed that the Mach contour show how the primary and induced flows mix in the divergent zone of the ejector, and that the induced flow does not follow the pathlines defined by the primary jet.

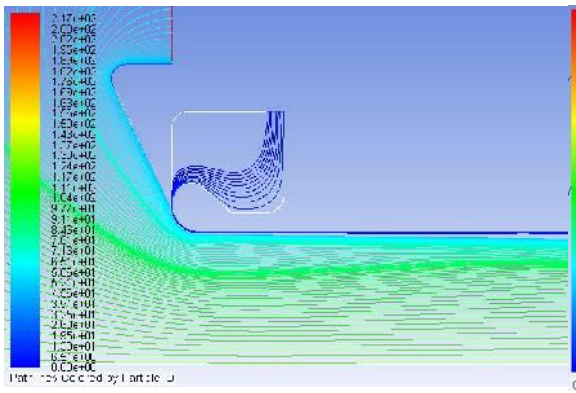


FIG. 3.. Pathlines pattern at the primary flow nozzle exit

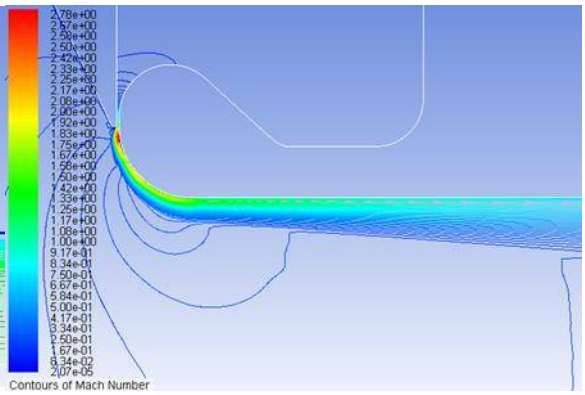


FIG. 4. Mach number contours at the ejector throat

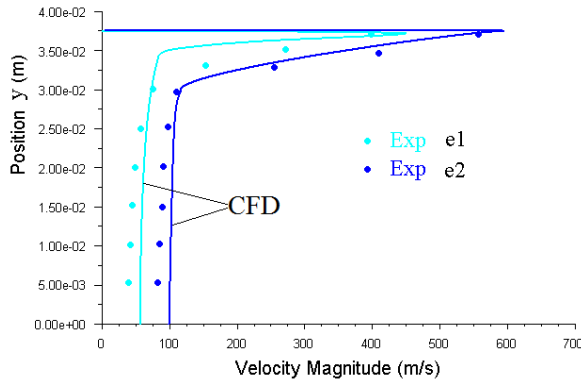


FIG. 5. Velocity profiles at x = 0.0 m

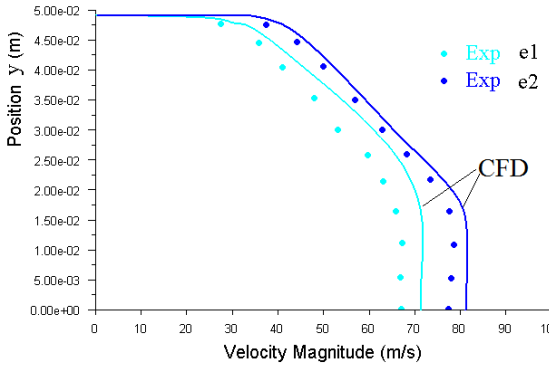


FIG. 6. Velocity profiles at x = 0.55 m

Figures 5-7 show the velocity magnitude or velocity profiles in different section of the ejector, for various primary nozzle gaps or other parameters (the Coandă surface radius, the inlet diameter).

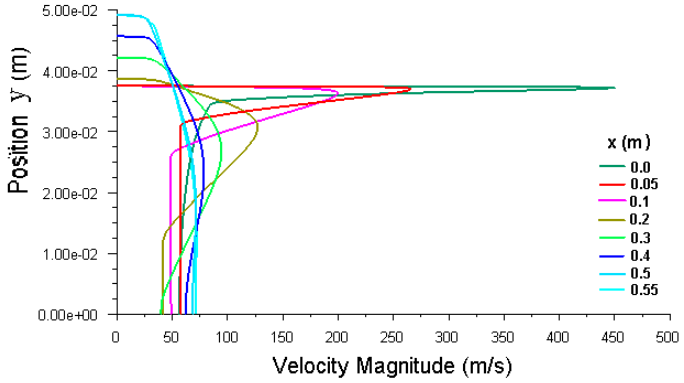


FIG. 7. Velocity magnitude in eight sections of the ejector (e_1=0.25)

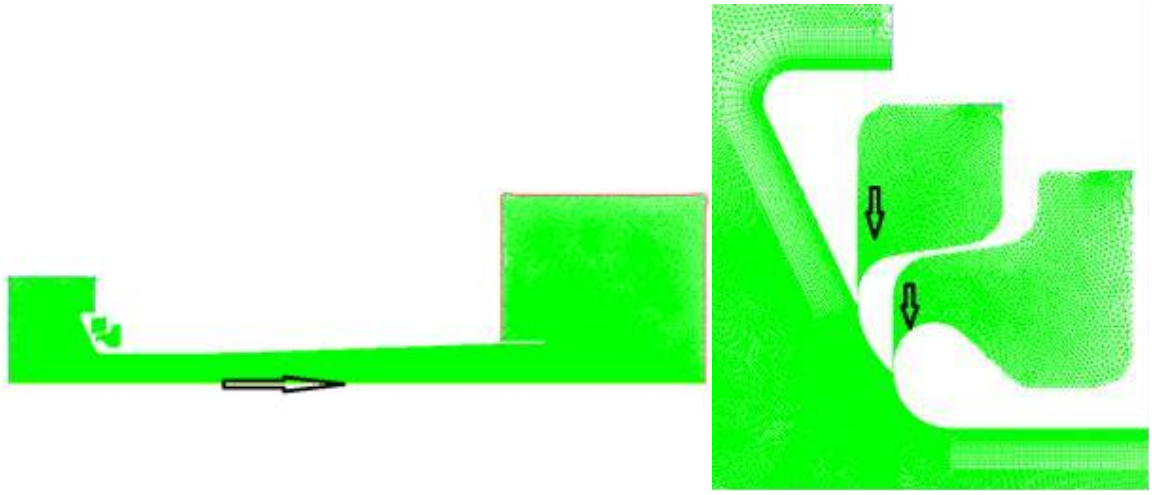
The mixing characteristics can be estimated based on the velocity profile shape, which depends, in fact, on the measure of the nozzle throat gap. The flattened shape of the profile denotes an almost complete mixing ratio between the primary and the induced jets. If this is obtained in a section closer to the inlet, this yields a better ejector performance.

The ratio of the induced mass flow rate to the primary mass flow rate per stagnation pressure inside the reservoir can be considered as the Coandă ejector performance index.

All these numerical investigations, together with the experimental ones, demonstrate the importance of the geometry and the primary jet characteristics in optimizing the Coandă ejector.

5. COANDA EJECTOR WITH TWO PRIMARY JETS

In the sequel, the effect of a Coandă ejector with multiple primary jets is analyzed, using the same steady RANS equations. The geometry of the analyzed configuration is shown in Fig. 8 (a, b). The computation grid (hybrid) is constructed with approx. 277,765 cells and has 161,155 nodes. Near the solid boundaries, the first node is positioned at 1e-6 m to provide the numerical representation of the viscous sublayer ($y^+ \approx 1$), the cell growth rate being 1.05.



a) b)

FIG. 8. The computing grid used for simulations a.); details for primary jets b.)

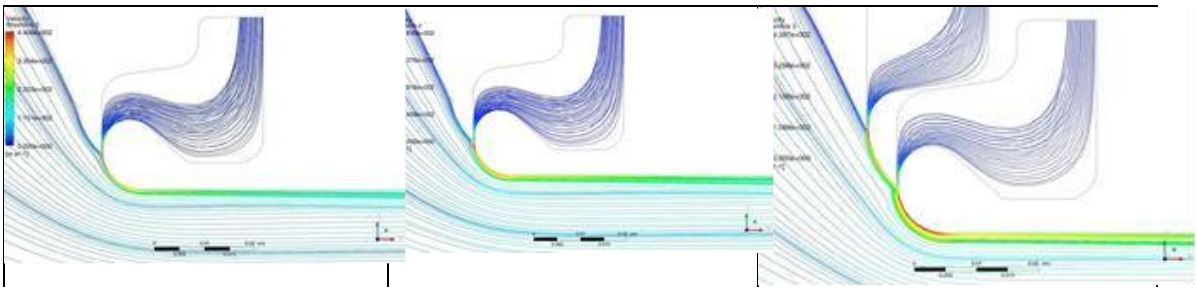
Since the supply pressure of the primary nozzles is high, the jets are supersonic at the nozzle outlet, requiring a numerical density-based approach, the implicit scheme. To accelerate the convergence process, the first-order spatial meshing numerical scheme is chosen. Once the convergence of 10^{-3} has been reached for the primitive variables, the computation switches to the second order scheme for the equations describing the flow, the equations for the turbulent kinetic energy and the specific dissipation rate. The number of iterations needed to achieve convergence is of order 10^4.

The following cases have been simulated:

1 .a.,b. The first primary nozzle closed and the second supplied from a reservoir with a pressure of: 3 bar - (a) and 6 bar - (b);

2 . Both primary nozzles supplied from a reservoir with a 3 bar pressure.

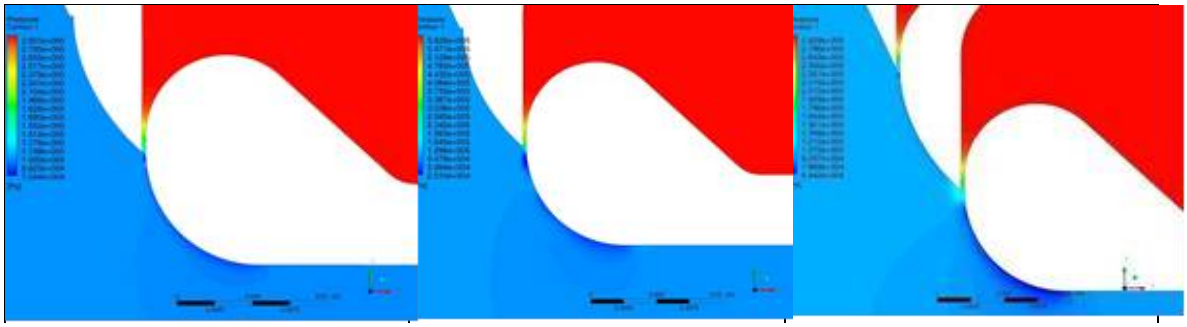
Fig. 9 shows the streamlines through the Coandă ejector in the mentioned configurations. Note that the attachment of the jet (supersonic) on the convex surfaces



1.a 1.b 2.

FIG. 9. Streamlines for the three analyzed cases (detail around the primary nozzles – 1.a, 1.b and 2.)

and entrainment of the air in front of the ejector. Fig. 10 shows the pressure distribution in the vicinity of the primary nozzles, for all three cases. Due to the pressure difference between the reservoir(s) and the middle area of the ejector, the critical flow parameters are reached in the nozzles, the formed jet being supersonic.



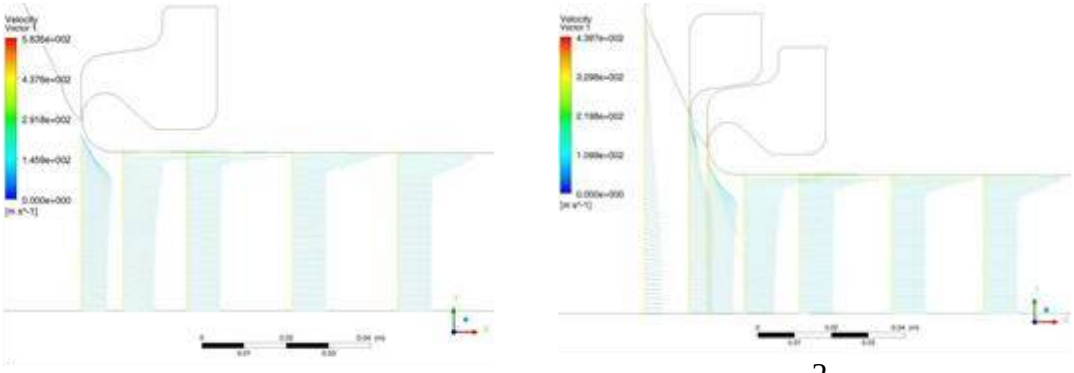
1.a 1.b 2.

FIG. 10. The pressure distribution around the primary nozzles for all three cases (1.a, 1.b and 2.)

Fig. 11 shows the velocity profiles in some typical sections (x_s = 0, 0.01, 0.025, 0.05, 0.075 m). The typical shape of the velocity profile for a jet in the presence of a surface is observed, as well as the effect of entrainment of the air through the ejector.

Table 1 shows the mass flow through the primary nozzles and through the inlet of the ejector.

Taking as reference case 1.a, note that in case 1.b the mass flow will increase with (0.64699-0.372522)/0.372522 x 100 % = 73.67 % and in the case of multiple ejector with (0.5776677-0.372522)/0.372522 x 100 % = 55.06 %. Although the supply pressure is doubled for the simple ejector it is observed that the entrained air mass-flow is not significantly higher than in a case of a multiple ejector supplied at moderate pressure.



1.b. 2.

FIG. 11. Velocity profiles in some typical sections two cases (1.b., 2.)

Table 1. Air mass flow through the ejector for the three cases

Case	Primary nozzle 1 [kg/s]	Primary nozzle 2 [kg/s]	Ejector inlet [kg/s]	Total mass flow through ejector [kg/s]
1.a	-----	0.04596412	0.32655846	0.37252258
1.b	-----	0.09327204	0.55371882	0.64699086
2.	0.0549416	0.04590953	0.47582627	0.57667746

From a technical point of view, it seems reasonable to use a multi-jet ejector supplied at moderate pressure rather than a simple high pressure ejector.

Another advantage is that of mixing layer growth in the ejector flow, which has the effect of increasing the performance of the ejector.

A weak point of the multiple nozzle ejector is related to its size increasing, to introduce a second air reservoir and, implicitly, increase its mass.

6. THRUST AND JET VECTORING

Mechanical deflection of the thrust involves engine nozzle deflection and, thus, physically modify of the main flow direction [5,6], but this can used complicatelly devices and actuators. Alternative method to mechanical deflection can be done using a secondary jet to entrainment the main jet (Fig. 12). The component force of the thrust vector $T_0, F_{z,tv}$ produces a pitch moment, $M_{z,tv}$ around airplane's center of gravity, allowing the airplane to be controlled in flight. This force is adimensionalisated to obtain the thrust coefficient $C_z = F_{z,tv}/T_o$, where C_z depends on the angle of the thrust vector

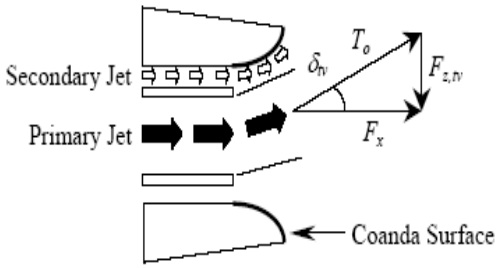


FIG. 12. The concept of thrust deviation

conform to equation $\delta_{tv} = \tan^{-1} C_z$. One must notice that deviation of the thrust force implies a change of the drag force. When $d_{tv} > 0$, the real force of the primar jet will be smaller then the resultant thrust force $F_x < T_o$.

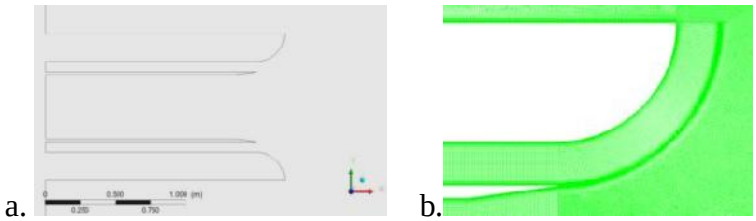
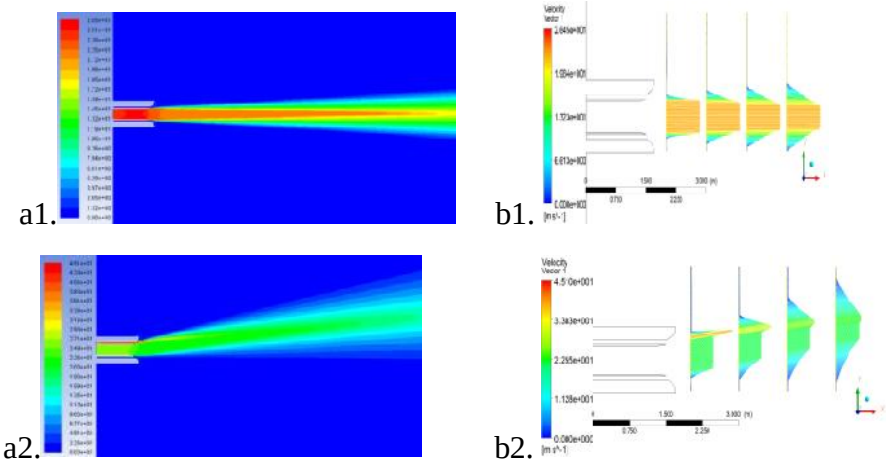


FIG. 13. The model used to highlight the change of the jet direction: a. the model geometry; b. detail of the computational grid.



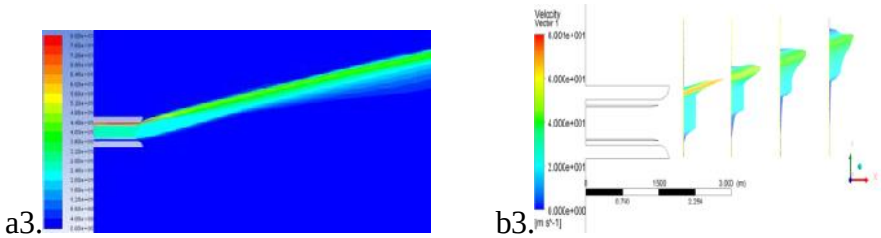


FIG. 14. The effect of secondary jet on the primary jet (Vj=25 m/s), the flow velocity field (a1-a3) and the velocity profiles (b1-b3) for 4 positions (2 m, 3 m, 4 m si 5 m).

The effect of the secondary flow on the main jet in the presence of a convex surface can be evidenced by numerical flow simulation on the configuration shown in Fig. 13. The main jet has a speed of 25 m/s, with a moderate turbulence degree. By varying the secondary jet velocity (considered only the upper jet in the presented geometric configuration), the results shown in Fig. 9 were obtained.

Figs. 14 a1-b1 correspond to a speed V_s = 0 m/s for the secondary jet, a2-b2 for V_s = 30 m/s, and a3-b3 for V_s = 70 m/s. From Fig. 9 it is observed that with the increase of the secondary jet velocity the deflection of the jet increases and the shape of the velocity profile in the main jet changes from a "full" velocity profile specific to the free jet to an asymmetric velocity profile with the maximum moved towards "the secondary jet". The deflection of the jet is "sustained" also by the shape of the exhaust surface (quarter circle). In Fig. 15 is shown the variation of the main jet angle deflection in relation to the secondary jet velocity.

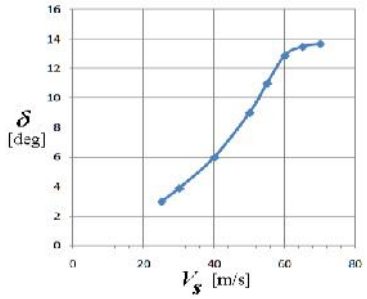


FIG. 15. The deflection of the main jet as function of the velocity of the secondary jet

If the secondary jet is accelerated over a Coandă surface, it will produce the local pressure drop and the appearance of the pressure gradient "perpendicular" to the main jet axis. This effect correlated with the friction effects leads to an increase in the fluid flow from the main jet to the secondary jet producing the change of the jet direction. Increasing the secondary jet velocity and the radius of curvature of the Coandă surface lead to a greater deflection of the main jet and obtaining the effect of the thrust vectorization. It is noted that for a secondary jet speed of over 60 m/s, the entrainment effect of the secondary jet decreases, the main jet being deflected very little or not at all.

7. STATIONARY BIFURCATION FLOW PHENOMENON INVESTIGATIONS

Qualitative changes occur in the structure of a flow, due to the Coandă effect, in some cases of two-dimensional channel flow configurations. In this paper two types of channel flows are numerically investigated, based on CFD approaches, in connection with the Coandă effect: the channel with or without sudden expansion inlet (y = 0 is a symmetry boundary, Fig. 16).

These qualitative changes are referred to as stationary bifurcations and in these cases they can be identified in the flow pattern as asymmetries that occur for certain values of the similarity parameter (Reynolds number, Rayleigh number), since, in general, the stationary Navier-Stokes boundary value problem is not uniquely solvable. These types of the instability phenomena or bifurcations may occur in fluid dynamics, already observed in early experiments [12], [13]. In [14] the pitchfork bifurcation flow in a symmetric 2D channel with contraction has been investigated.

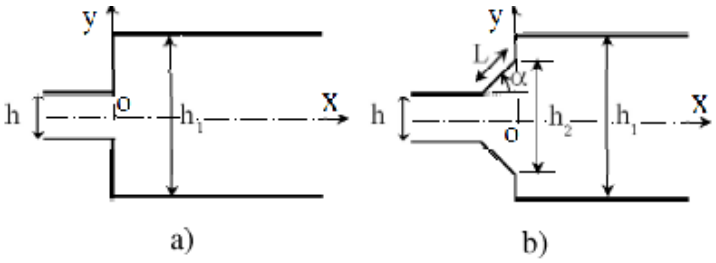


FIG.16. Geometry of the channel: a) sudden expansion; b) sudden expansion with divergent

A. The Physical and Numerical Formulation

The Navier-Stokes equations are governing the stationary, laminar, incompressible flow through the considered 2-D channels:

$$\nabla \vec{V} = 0$$
$$\rho\left(\vec{V}\cdot\nabla\right)\vec{V} = -\nabla p + \mu\nabla^2\vec{V} \tag{8}$$

$$u(y) = U_{\max}\left[1-\left(\frac{y}{y_{\max}}\right)^2\right] \tag{9}$$

where $y_{\max}$ is the channel width in the expansion zone (h or h_2). A no-slip boundary condition ($u = 0$) is imposed on the rigid walls of the channel and at the exit the boundary condition is applied, $\sigma \cdot n = 0$, where σ is the stress tensor and n is outward normal of the exit boundary.

The incompressible Navier-Stokes equations are solved using the SIMPLE (Semi-Implicit Method for Pressure Linked Equations) method introduced by Patankar [15]. The Reynolds number is based on velocity $U_{\max}$ and the height of the channel at the exit before the sudden expansion: $\mathrm{Re} = \rho U_{\max} h/\mu$, where ρ is the fluid density and μ is the dynamical viscosity.

B. Numerical Results and Discussions

Airflows characteristics have been numerically investigated through two channel configurations: sudden expansion, sudden expansion with divergent ($h_1 = h_2$).

For the sudden expansion configuration, the symmetry of the flow (Fig. 17) is noticed, but after the Reynolds number increases to a critical value of 228, the symmetry of the flow through the channel is lost, hence the flow becomes asymmetric (Fig. 18).

Regarding the wall shear-stress on the axial direction it is noted that it has different values for the upper and lower wall adjacent to the expansion zone and the recirculation area (where it has negative values).

There is a good correlation between the distribution of the wall shear stress and the length of the recirculation zone portion of the upper wall, respectively, lower.

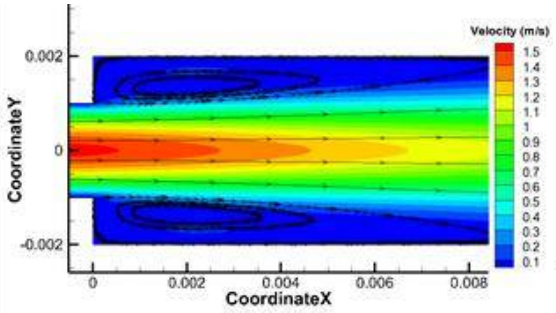


FIG. 17. The streamlines pattern and the velocity distribution before bifurcation, $\mathrm{Re} \approx 210$; ($h = 2$ mm, $h_1 = 4$ mm)

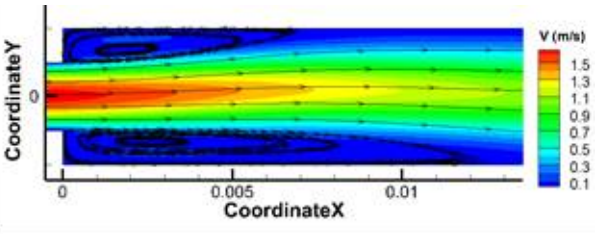


FIG. 18. The streamlines pattern and the velocity distribution after bifurcation, $\mathrm{Re} \approx 228$; ($h = 2$ mm, $h_1 = 4$ mm)

One of the recirculation zones is growing faster on one wall than the other, resulting in the attachment of the jet to this wall. The effect of this phenomenon occurring due to the impulse of a disturbance, is the deflection of the jet towards one of the walls. Hence the velocity is increasing along the wall, while the pressure is decreasing leading to the deflection of the jet. All these are actually the result of the Coandă effect.

In the second case, Fig. 19 shows the vertical velocity of the flow through the divergent channel with sudden expansion ($h_1 = h_2 = 8$ mm, $h = 2$ mm, $\alpha = 40$ deg) before the bifurcation (Re = 53), when the symmetry is observed. The grid has 92,000 quadrilateral cells with maximum resolution in the vicinity of the expansion zone, $2 \cdot 10^{-5}$ m.

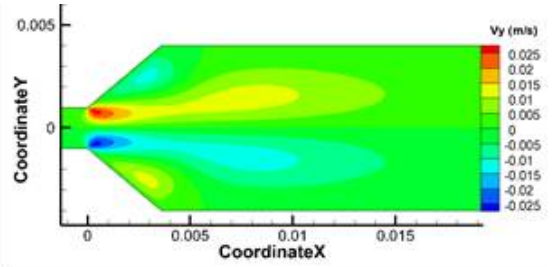


FIG. 19. The vertical velocity in the channel before bifurcation

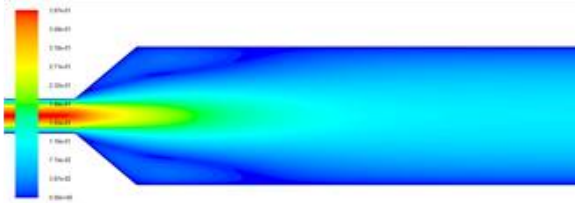


FIG. 20. Velocities spectrum through the channel with divergent before bifurcation, Re = 53 ($h_1 = h_2 = 8$ mm, $h = 2$ mm, $\alpha = 40$ deg)

Furthermore, Fig. 20 shows the absolute values of the velocities spectrum through the same channel under the same assumptions.

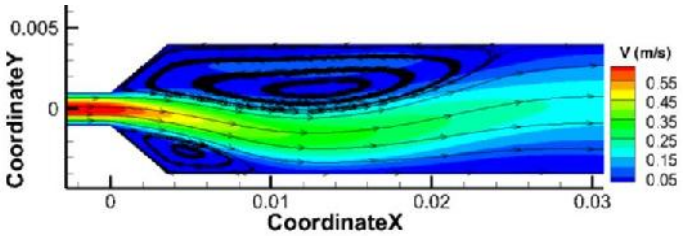


FIG. 21. The streamlines pattern and the velocity distribution after bifurcation, $\mathrm{Re} \approx 90$

If the Reynolds number goes over the value of 90, the symmetry of the flow vanishes as noted in Fig. 21.

These figures emphasize the asymmetries of the flow representing the bifurcations of the flow starting with the critical value of the Reynolds number. Note that these are stationary bifurcations.

Values of the critical Reynolds numbers (those from which bifurcations occur) decrease as the expansion ratio parameter increases ($k_e = h_1 / h$) or when the divergence angle (α) increases, as observed in numerical investigations.

For flows with Reynolds numbers larger than the critical values, the Hopf bifurcation phenomenon might occurs, which is periodic.

The critical values of the Reynolds number are corresponding to the values existing in the literature, yielded both numerically and experimentally [16]-[18].

CONCLUSIONS

By a computational study the effect of various geometric parameters on the performance of the Coandă ejector has been analyzed. The throat gap of the primary nozzle ('*e*') has a strong influence on the ratio of mass flow rates of the induced flow and the primary flow and a critical control over the mixing length as well. For reduced throat gaps, the mixing length decreased, and this possibly indicates the rapid mixing layer growth in the ejector.

The goal has been to investigate the influence of various geometric parameters and pressure ratios on the Coandă ejector performance. The effect of various factors, such as the pressure ratio, primary nozzle and ejector configurations on the system performance has been evaluated based on the performance parameters. The mixing layer growth plays a major role in optimizing the performance of the Coandă ejector as it decides the ratio of secondary mass flow rate to primary mass flow rate and the mixing length.

Also the effect of a Coandă ejector with multiple primary jets has been analyzed. From a technical point of view, it seems reasonable to use a multi-jet ejector supplied at moderate pressure rather than a simple high pressure ejector. Another advantage is that of mixing layer growth in the ejector flow, which has the effect of increasing the performance of the ejector.

The application of the Coandă effect to the directional control of a jet is presented. Deviation of the thrust force by direct flow can be achieved by using the Coanda effect to change the angle of the primary jet engine exhaust nozzle. This effect correlated with the friction effects leads to an increase in the fluid flow from the main jet to the secondary jet producing the change of the jet direction.

Because single jet flows or multi-jet flows are extensively applied in conjunction with the Coandă surface, as confined or free jet flows, in the last part of the paper we have provided further insight into complexities involving issues such as the variety of flow structure and the related bifurcation and flow instabilities. Qualitative changes occur in the structure of a flow, due to the Coandă effect, in some cases of two-dimensional channel flow configurations. These qualitative changes are referred to as stationary bifurcations and in these cases they can be identified in the flow pattern as asymmetries that occur for certain values of the similarity parameter (Reynolds number, Rayleigh number), since, in general, the stationary Navier-Stokes boundary value problem is not uniquely solvable.

For future work, further numerical and theoretical investigations will be done for more complex channel configurations at larger Reynolds numbers with the goal of determining the detailed physics of the flow through such channel. Furthermore, the advantages and the limitations of the use of the Coandă effect will be identified.

AKNOWLEDGMENT

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A STUDY ON RECOIL INTENSITY OF THE CO_2 POWERED RECOIL SIMULATOR

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Abstract: *The paper is focused on the study on the recoil intensity of the carbon dioxide (CO_2) powered recoil simulator. The objective is to develop a mathematical model for the calculation of the force and its impulse acting on the mount of a rifle with a CO_2 powered recoil simulator inside. The problem is solved using the MATLAB environment, and results of the theoretical solution are verified experimentally on the tubeless recoil simulation kit for the assault rifle AK47.*

Keywords: *recoil, recoil simulation, force, impulse, recoil intensity, carbon dioxide, AK47*

1. INTRODUCTION

The virtual shooting training system including realistic simulated weapons or recoil kits for real firearms has become a solution to increase the effectiveness and safety of shooting and tactical training. There are a number of commercial recoil simulators on the market, for example [1-3]. All of them use the carbon dioxide as the power gas. By using compressed gas instead of live ammunition a large number of simulated rounds can be fired for a minimal cost.

One of engineering challenges in designing recoil simulators is that of obtaining the recoil intensity that is close to that generated by the real firearm. The recoil intensity is represented by the resultant force and impulse transmitted from the device to the shooter.

There is almost no available literature on simulation of the recoil intensity of the CO_2 powered recoil simulator. There are several related publications appearing in the last few years and documenting the development and testing of the experimental spring powered mechanical device for the simulation of the gun's recoil [4], and dynamic analysis of the gas powered impulse generator [5].

In this paper, a mathematical model for the calculation of the force and its impulse acting on the mount of a rifle with a CO_2 powered recoil simulator inside is formulated. The developed mathematical model is validated and experimentally verified on the CO_2 powered recoil simulator for the assault rifle AK47.

2. PRINCIPLE OF CO_2 POWERED RECOIL SIMULATOR OPERATION

Figure 1 shows the basic concept of a CO_2 powered recoil simulator consisting of a piston, a control valve system, and a return spring. The cylinder is connected with the pressure tank through the control valve system that controls the amount of CO_2 discharged from the pressure tank into the cylinder.

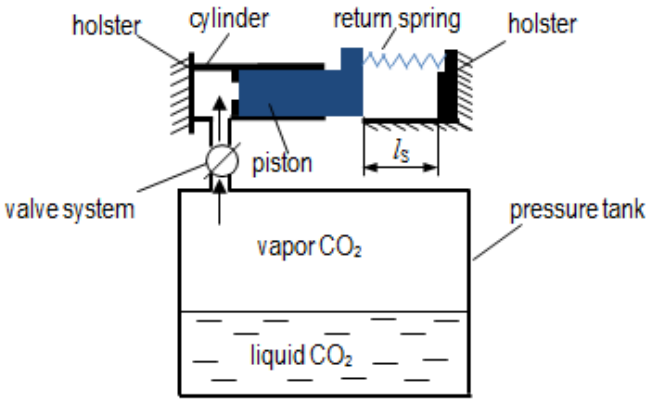

FIG. 1. Schematic of the recoil simulator powered by CO_2

When the valve is opened by the trigger, a certain amount of CO_2 vapor discharges out of the pressure tank through the valve into the cylinder, in which the pressure increases rapidly, acts on the front of the piston and causes the piston to move backward. At the moment, when the piston reaches its working stroke, it reaches the impact velocity and collides with the device holster in the back position resulting in generating the impact force F_{IB}. After that, the piston returns to the initial position by the return spring force. Then, it collides with the gun holster in the front position and generates the impact force F_{IF}. The resultant force of impact forces, the pressure force and the return spring force are transmitted from the device to the mount resulting in the recoil effect.

3. MATHEMATICAL MODEL

3.1. Dynamics of the recoil simulator

The force and impulse transmitted from the recoil simulator to the mount can be determined based on dynamics of the moving part, i.e. the piston.

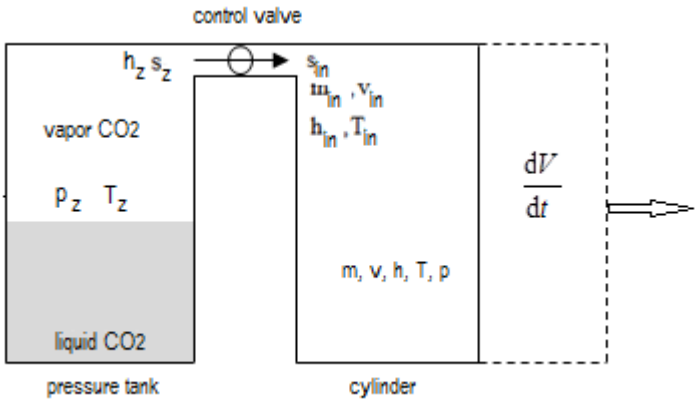

FIG. 2. Open thermodynamic system

Dynamics of the recoil simulator has comprehensively studied in [6], in which the above schematic of the CO_2 powered recoil simulator is replaced by the thermodynamic system shown in Fig. 2. Here, the author developed an equilibrium discharge mathematical model for carbon dioxide tanks in order to assume thermodynamic equilibrium states at every point in time throughout discharging under ambient temperature conditions. The speed of sound in a two-phase saturation is taken into consideration for the calculation algorithm [6]. Results of solution of the mathematical model describing dynamics of the recoil simulator are the piston velocity and displacement time courses, and the time change in pressure behind the piston.

3.2. Force and impulse calculation

The value of the force F_{B} transmitted from the recoil simulator to the gun's mount is given by the following expression:

$$F_{\mathrm{B}} = -F_{\mathrm{p}} + F_{\mathrm{sp}} + F_{\mathrm{IB}} + F_{\mathrm{IF}}, \tag{1}$$

where:

- F_{p} is the pressure force,
- F_{sp} is the return spring force,
- F_{IB} is the impact force in the back position,
- F_{IF} is the impact force in the front position.

The pressure force F_{p} is given by the difference in the compression cylinder pressure and the atmospheric pressure behind the piston:

$$F_{\mathrm{p}} = A_{\mathrm{p}}\left(p - p_{\mathrm{a}}\right). \tag{2}$$

The return spring force F_{sp} is generally given by the return spring constant c and the working stroke that is equal to the piston displacement x_{p}. It is necessary to take also the return spring preload into consideration. In this case, the return spring is initially compressed. Hence, we can express the spring force in the form

$$F_{\mathrm{sp}} = F_{\mathrm{ini}} + cx_{\mathrm{p}}, \tag{3}$$

where the force F_{ini} is the initial compression spring force corresponding the initial spring compression, which is determined by the summation of the working and spring preload.

The resultant impulse of the force F_{B} can be calculated by the following formula:

$$I_{\mathrm{B}} = -I_{\mathrm{p}} + I_{\mathrm{sp}} + I_{\mathrm{IB}} + I_{\mathrm{IF}}. \tag{4}$$

Where the impulses of the pressure force and the return spring force can be calculated by Eq.(5) and Eq.(6), respectively.

$$I_{\mathrm{p}} = \int_0^{t_1} F_{\mathrm{p}}\,dt, \tag{5}$$

$$I_{sp} = \int_0^t F_{sp} dt. \tag{6}$$

In order to determine the impulse of impact force in the back and the front position we apply Newton's impact theory based on the known piston's velocity v_P. Then, the impulse of impact force in the back position I_{IB} is given by

$$I_{IB} = m_P \left(v_{P2} - v_{P1} \right), \tag{7}$$

where m_P accounts for the mass of the moving part, v_{P1} and v_{P2} represent the piston velocity before and after its collision with the gun's holster, respectively.

The impulse of impact force in the front position is given by:

$$I_{IB} = m_P v_{P3}, \tag{8}$$

where v_{P3} denotes the piston velocity before it collision with the gun's holster in the front position.

Once, the value of the impulse of impact force is known, the average value of the impact force in the back and the front position can by calculated by:

$$F_{IB} = \frac{I_{IB}}{\Delta t_{IB}}, \text{ and } F_{IF} = \frac{I_{IF}}{\Delta t_{IF}}, \tag{9}$$

where Δt_{IB} and Δt_{IF} is the time of collision in the back and the front position, respectively.

4. VALIDATION AND VERIFICATION OF MATHMATICAL MODEL

In order to present results of the solution, the above-described algorithm for calculation of the force and impulse acting on the weapon mount is validated on the tubeless recoil system for the AK47. The 3D view of the tubeless is shown in Fig. 3.

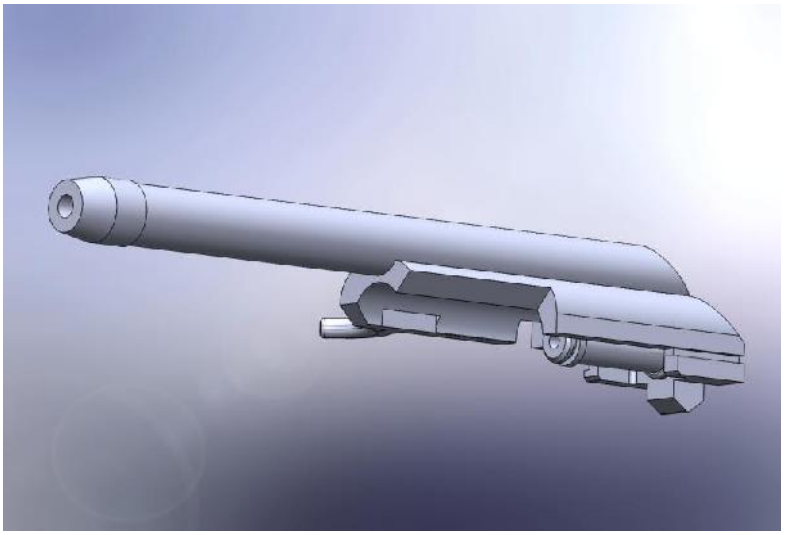

FIG. 3. 3D view of the tubeless recoil system

The mathematical model presented in [6] describing dynamics of the tubeless recoil system was solved by numerical integration with MATLAB using the explicit fourth-order Runge-Kutta method. The mathematical model considers a range of input data parameters and boundary conditions (see Table 1), i.e. the initial cylinder volume, the initial temperature, the pressure tank's specific enthalpy and entropy of CO_2, the mass of the piston, the return spring constant, the discharge coefficient, etc.

Table 1. Initial data parameters and boundary conditions

Quantity	Value	Quantity	Value
Initial cylinder volume (ml)	0.085	Return spring constant (N/m)	290
Cylinder diameter (mm)	12	Return spring mass (kg)	0.026
Piston mass (kg)	0.357	Control valve diameter (mm)	4.65
Piston working stroke (mm)	118	Initial cylinder temperature (K)	288
Discharge coefficient	0.7		

FIG. 4. View of the experimental setup:1 – ballistic computer, 2 – AK 47 rifle with tubeless recoil system inside, 3 – piezoelectric force sensor, 4 – mobile firing rest, 5 – elastic stay.

For the purpose of verifying the calculated results experiments were held in the balistic laboratory of the Department of weapons and ammunition of the University of Defence in Brno. In order to record the force F_B and the impulse I_B transmitted from the weapon system to the mount the a piezoelectric annular force sensor is located between the gun back position and the stock of STZA 12 mobile firing rest. Measurement signals are collected by the ballistic computer. The view of the experimental setup is shown in Fig. 4. The mobile firing rest STZA 12 is appointed for the working site the job of which is the testing of small arms, ballistic gauges and cartridges within the caliber up to 12.7 mm. The force piezoelectric sensor KISTLER-9051A of the serial number 1788437 is set to the sampling frequency of 303030.31 Hz. The force measuring range is from 0 kN up to 120 kN, and the nominal sensitivity is - 4.301 pC/N.

The result of the experiment is the time course of the force transmitted from the system to the sensor. Then, the impulse is the integral of the force with respect to time.

The experimentally obtained values of the force and its impulse are compared with the theoretical results of solution of the developed mathematical model in Fig. 5 and Fig. 6.

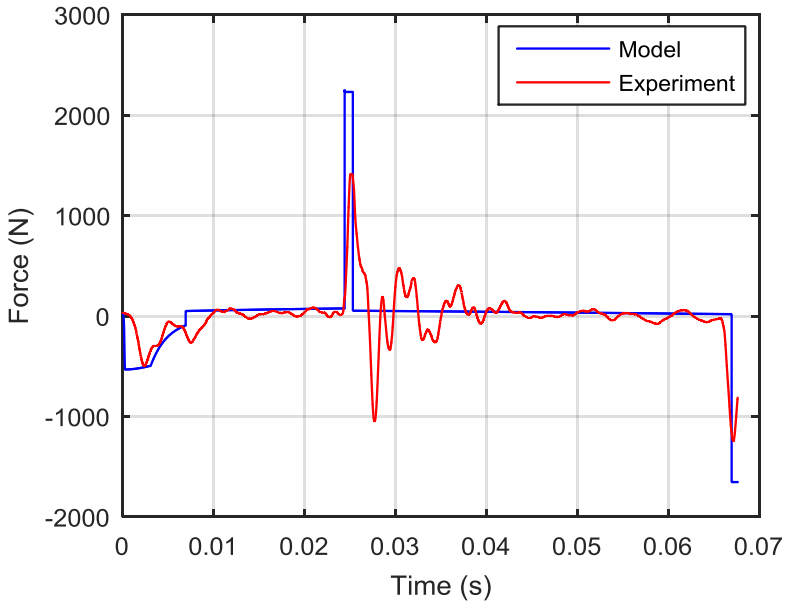

FIG. 5. Time course of force acting on the weapon mount

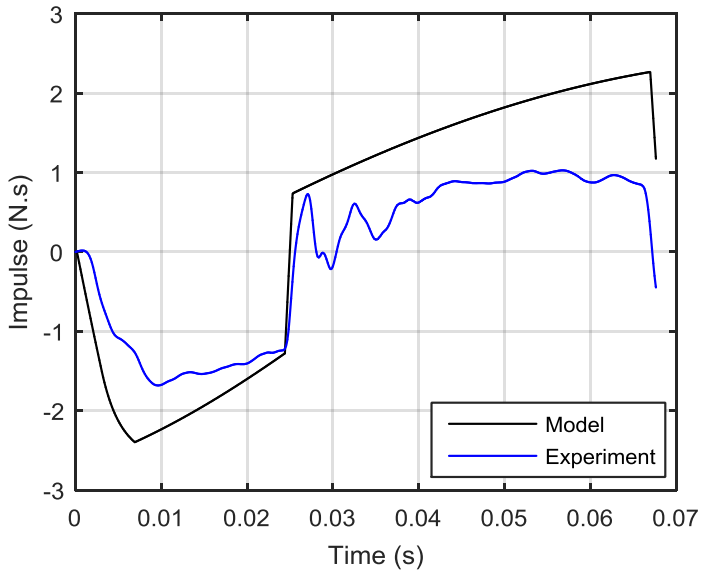

FIG. 6. Time course of the impulse of force acting on the weapon mount

It can be seen that the experimentally obtained values of force transmitted from the gun to the mount are smaller than the calculated values, because the force sensor is connected to the gun stock through an elastic stay (i.e. the rubber layer). The schematic of the sensor arrangement is shown in Fig. 7. We assume that the elastic stay between the gun stock and the sensor has non-linear stiffness *k*. Then, the force from the elastic stay is given as bellow:

$$F_{\mathrm{ES}} = F_{\mathrm{ES0}} + kx, \tag{10}$$

where F_{ES0} accounts for the initial elastic stay force, x denotes the compression.

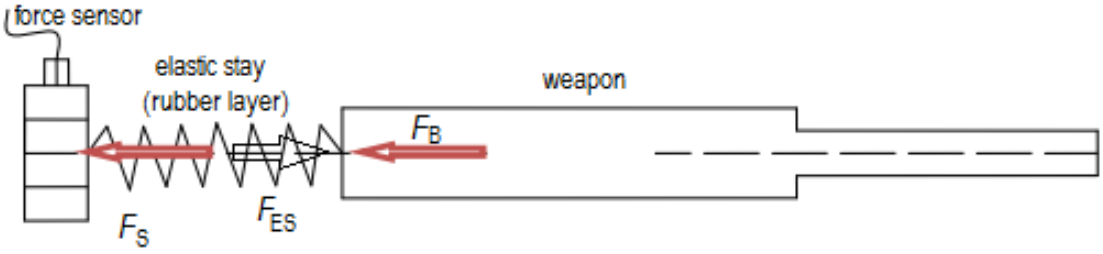

FIG. 7. Schematic of sensor seating

Determination of the exact value of the rubber layer stiffness k is beyond the scope and purpose of the present research. During shooting, the force F_B is transmitted from the weapon to the force sensor. The resultant force F_S acting on the sensor is given by

$$F_S = F_B - F_{ES} \tag{11}$$

Equation (11) indicates that the experimentally obtained force F_S is smaller than the real force F_B acting on the weapon while shooting, but the forces F_S and F_B have the same tendency.

5. CONCLUSIONS

In this paper, the mathematical model for the calculation of the recoil intensity of the CO_2 powered recoil simulator has been formulated. The problem has been solved numerically using the Runge-Kutta method in MATLAB environment.

The developed mathematical model was verified on the tubeless recoil simulation kit for the assault rifle AK47 by the measurement of force acting on the weapon mount using the piezoelectric force sensor. The model provides good agreement with measured data. Obtained results enable us to analyze various influences of changes in several design parameters on the recoil intensity.

ACKNOWLEDGMENT

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INVESTIGATION OF TWO 2D PROPELLER CALCULATION METHODS AND THE DEPENDENCY OF THE SOLUTION IN RELATION TO THE NUMBER OF CALCULATION POINTS

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Abstract: *This paper presents two simple implementations of blade element method used for propeller performance calculation – Blade Element Momentum Theory and Joukowsky method based on a simple vortex model. In principle, both methods require division of the blade of the propeller into finite number of sections (i.e. calculation points), over which a 2D flow is assumed. The focus of this paper is to investigate the dependency of the calculated solution on the number of sections and comparison of both methods. For this purpose, three propeller geometries were chosen and a simple method used for comparison was developed. The calculation was performed in LabVIEW interface implementing MATLAB code.*

Keywords: *Blade Element Momentum Theory, Joukowsky method, propeller performance, LabVIEW*

1. NOMENCLATURE

B [1]	Number of Blades	
c [m]	Local chord length	
$\bar{c}$ [1]	Relative chord length	$\bar{c}=cD$
$\bar{r}$ [1]	Dimensionless radius	$\bar{r}=rR$
t [m]	Local thickness	
$\bar{t}$ [1]	Dimensionless thickness	$\bar{t}=tc$
U1 [ms-1]	Angular flow velocity vector	
V1 [ms-1]	Axial flow velocity vector	

2. INTRODUCTION

With advances of the unmanned aerial vehicles (UAVs) and new technologies to manufacture propellers, a need arises to quickly and efficiently calculate the propeller characteristics. While it is possible e.g. to implement a CFD calculation to obtain precise results, the tuning of the calculation is challenging and it does take considerable time [1].

Blade element methods (BEM), while conceptually simple, provide sufficiently precise results and due to their relative simplicity, they are widely used not only to perform the initial aerodynamic analysis, but also to optimize the design and calculate the aerodynamic loads acting on the propeller. These methods are also suitable to calculate the performance of the wind turbines. [2]

This paper presents the more traditional Blade Element Momentum Theory (BEMT), which couples the classical BEM with the momentum theory and Blade Element Joukowsky Method, which implements circulation distribution calculation along the rotor blade based on the Joukowsky theorem. Both methods have fundamentally the same assumptions [3]:

- The rotor can be represented by a finite amount of sections and the flow around each section can be approximated by a 2D flow around the airfoil
- The rotor is lightly-loaded
- The wake behind the rotor is cylinder-like
- The inflow is axisymmetric to the axis of rotation (zero yaw angle)
- The rotor geometry is known
- The airfoil polar in each calculated section is known
- The blades of the propeller are infinitely stiff

This paper closely inspects the influence of the number of calculation points given by the rotor division to the solution. For this purpose, three different rotor geometries were assumed and the number of sections (or calculation points) varies from 10 to 60. The overall propeller characteristics are observed and compared.

3. INPUT DATA

3.1 Rotor Geometries. Three rotor geometries were assumed. The first rotor is a helicopter rotor with a simple flat plate geometry. The second one is a modeler rotor from a propeller model aircraft. The third one is from a small propeller aircraft. The rotor geometries are shown in the Fig. 1.

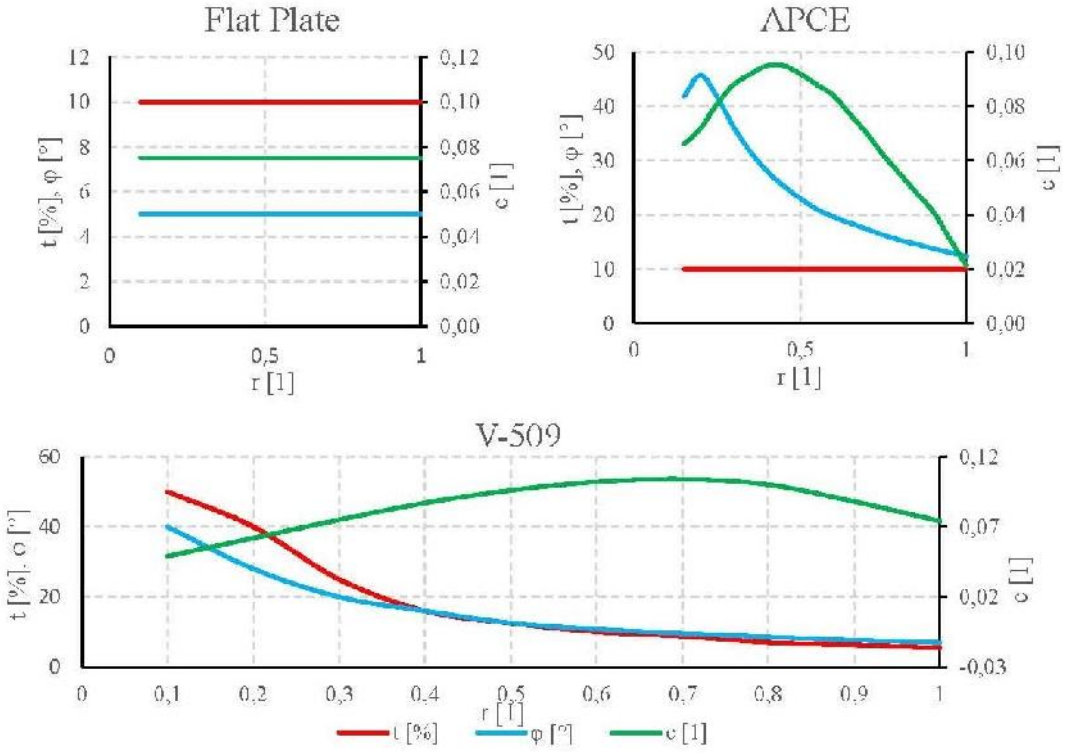

FIG. 1. Rotor geometries. First rotor is a simple flat plate typically used on helicopter rotors. APCE is a small modeller rotor and V-509 is propeller used on small propeller aircraft (L-410).

3.2 Airfoil Data. The rotor is then divided into finite number of sections, in which 2D flow over an airfoil is assumed. In order to perform the calculation via blade element method, the airfoil polar has to be known. Typically, the airfoil data can be measured or calculated. The measured data can be obtain e.g. from NTRS servers [4]. However, it is very difficult to obtain the measured polar for all Reynolds numbers and all airfoil thicknesses achieved along the rotor radius.

It is possible to calculate the polar e.g. in CFD or use other analytical methods. For purposes of this article, a paneling method developed by Drela and implemented in XFOIL was used [5].

XFOIL can be used to obtain precise data in pre-stall regimes. The iterative solution of BEMT or Joukowsky method can lead to values of angle of attack (AoA) greater than a stall angle. It is necessary to extrapolate the calculated polar to full ±180°. The extrapolation was performed by Viterna-Corrigan method further described in [6]. Comparison of extrapolated data calculated in XFOIL, CFD and measured data is described in [7] and an example of the airfoil polar is shown in Fig. 2.

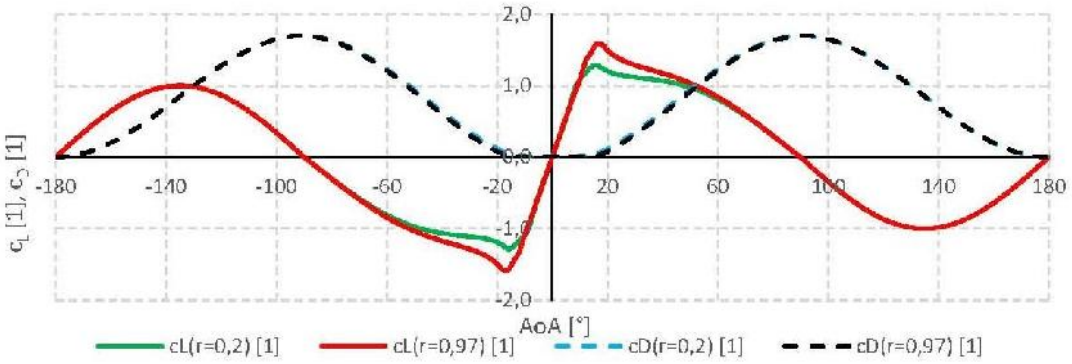

FIG. 2. The lift and drag polar for NACA 16 for first and last element calculated in XFOIL and extrapolated by Viterna-Corrigan

Snel [8] and subsequently Selig [9] showed that the assumption of 2D polar leads to underprediction of propeller performance due to the rotational effects influencing the flow over the airfoil. The rotational effects cause a shift in the stall angle into higher values of local AoA. However, for purposes of this paper these corrections were not implemented.

4. BLADE ELEMENT METHODS

Both Blade Element Momentum Theory and modified Joukowsky theorem implement Blade Element Method, while combining it with Momentum theory, or Joukowsky theorem, respectively.

4.1 Blade Element Method. The first step of the BEM theory is the subdivision of the blade into the finite amount of blade elements, as shown in the Fig. 3.

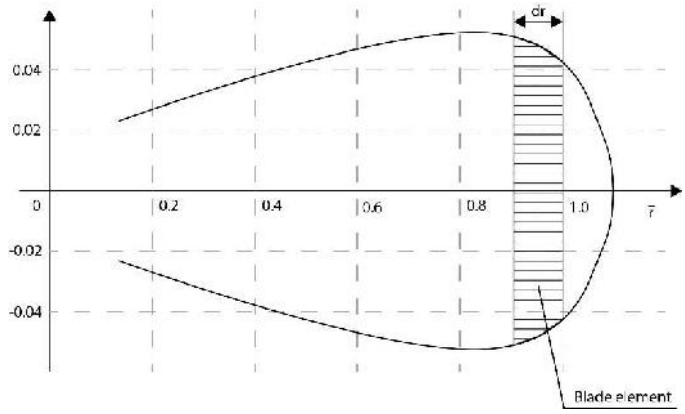

FIG. 3. The subdivision of rotor into finite amount of blade elements

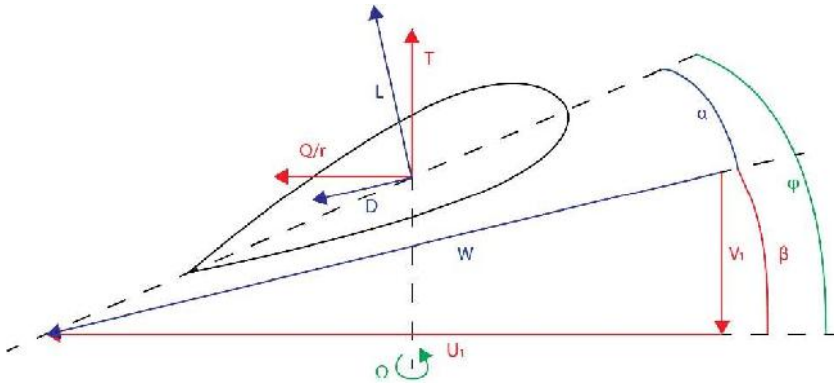

FIG. 4. The local element velocities and angles

In order to quantify the element aerodynamic properties, it is necessary to know the local angle of attack (AoA) α. Based on the Fig. 4 the AoA is equal to the difference of the geometric pitch angle φ and a local inflow angle β:

$\alpha=\varphi-\beta$

Assuming the blade motion is sufficiently small, the inflow angle β is then equal to:

$$\beta = \tan^{-1}\frac{V_1}{U_1}$$

The local lift L and drag D of the element can be calculated as:

$$\mathrm{d}L = c_L\frac{1}{2}\rho W^2 c\mathrm{d}r$$

$$\mathrm{d}D = c_D\frac{1}{2}\rho W^2 c\mathrm{d}r$$

The thrust dT and the torque moment dQ produced by B blades can be obtained by a simple trigonometry based on the Fig. 2:

$$\mathrm{d}T = \frac{1}{2}\rho W^2 c(c_L\cos\beta - c_D\sin\beta)B$$

$$\mathrm{d}Q = \frac{1}{2}\rho W^2 cr(c_L\cos\beta - c_D\sin\beta)B$$

4.2 Momentum Theory. According to the momentum theory, the thrust produced by the propeller is equal to change in the momentum of the flow passing through the propeller disk and the torque is equal to change in the angular momentum of the flow and radius:

$$\mathrm{d}T = 2\pi r\rho W(V_w - V)\mathrm{d}r$$

$$\mathrm{d}Q = 2\pi r\rho W(2a'\Omega r - 0)\mathrm{d}r$$

where V_w is the velocity in the far wake, r is local radius and is the rotational augmentation factor. It can be shown that:

$$V_w = V(1+2a)$$

$$W = \frac{V+V_w}{2} = V(1+a)$$

where is the tangential augmentation factor. After few simple rearrangements, the thrust and torque can be expressed as:

$$\mathrm{d}T = 4\pi r\rho V^2(1+a)\mathrm{d}r$$

$$\mathrm{d}Q = 4\pi r^3\rho V(1+a)a'\Omega\mathrm{d}r$$

By rearrangement of the aforementioned equations, we can come to an iterative process used to calculate the rotational and tangential augmentation factors a' and a.

4.3 Joukowsky Theorem. In order to correctly calculate the values of velocities and , Joukowsky theorem can be used. The flow over the blade section is approximated by the dimensionless circulation , which can be expressed as:

$$\bar{\Gamma} = \frac{B}{4\pi}c_L\bar{c}\frac{U_1}{R\Omega\cos\beta}$$

The velocities and can be expressed as the function of the dimensionless circulation :

$$U_1 = \left(\bar{r} - \frac{\bar{\Gamma}}{\bar{r}}\right)R\Omega$$

$$V_1 = \left(\frac{\lambda}{2\pi} + \sqrt{\left(\frac{\lambda}{2\pi}\right)^2 + \bar{\Gamma}(\bar{\Gamma}-1)}\right)R\Omega$$

By combining the aforementioned equation with Blade Element Theory, it is possible to calculate the dimensionless circulation by an iterative process. The thrust and torque of the blade section are then equal to:

$$dT = \frac{1}{4}B\bar{c}\rho D^2\Omega\frac{U_1}{\cos\beta}(c_L U_1 - c_D V_1)$$

$$dQ = D^2\pi^2 rB\bar{c}\frac{U_1}{\cos\beta}(c_L V_1 + c_D U_1)$$

4.4 Tip loss problem. Figure 5 shows the distribution of the circulation along the dimensionless radius as calculated by the Jouowsky theorem. Similar distribution can be obtained by BEMT. The circulation was not calculated for , because the propeller in this region does not produce any thrust. However, because both theories are derived for azimuthally independent stream tubes, they are only valid for infinitely many blades [10]. Prandtl showed that for a finite blade, due to the pressure equalization between upper and lower parts of the blade at its tips, the produced lift (and subsequently circulation) is equal to zero [11]. Glauert [12] derived Prandlt's tip loss factor for BEMT. While typically a Prandtl's tip loss model is implemented for wind turbine calculations, e.g. in [13] it is used for propeller calculation. A similar tip loss factor was derived for Joukowsky theorem.

For purposes of this paper, a simplest tip-loss factor was assumed. The thrust of the propeller is proportional to the integral of the circulation.

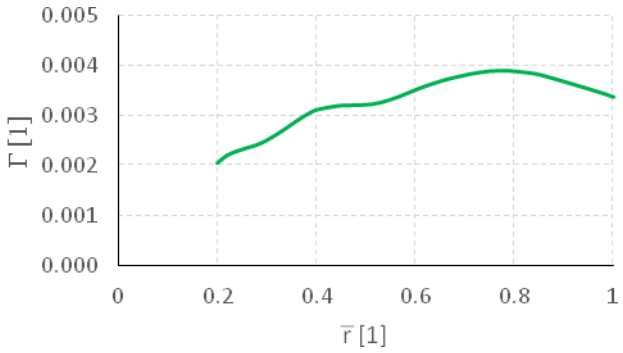

FIG. 1. The distribution of the dimensionless circulation along the without the tip loss model assumed

4.5 Performance coefficients. The propeller performance is typically expressed as a function of thrus $\bar{r} < 0.97$ower coefficie and efficiency. The coefficients can be calculated as:

$$c_T = \frac{T}{\rho n^2 D^4}$$

$$c_N = \frac{N}{\rho n^3 D^5} = 2\pi c_Q$$

$$\eta = \frac{c_T}{c_N}\lambda = \frac{c_T}{2\pi c_Q}\lambda$$

Typical propeller performance characteristics are shown in the Fig. 6.

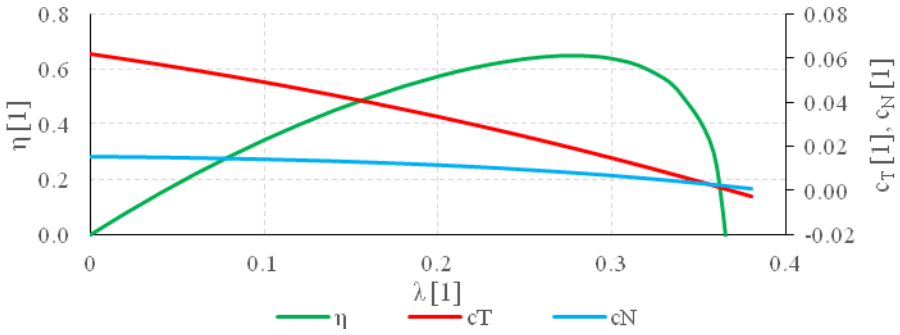

FIG. 2. Calculated propeller performance characteristics of a third propeller

5. CONVERGENCE INVESTIGATION

The propeller performance characteristics, as shown in the Fig. 6, were calculated for diffrent number of calculation points varying from 10 to 60. The upper limit was chosen due to the time load of the calculation itself – with 60 calculation points, it is necessary to actually calculate 60 diffrent airfoil polars. The comparison was performed followingly:

$$\eta_{\%} = \left|\frac{\eta_n - \eta_{n+10}}{\eta_{n+10}}\right| 100\ [\%]$$

where n is the number of calculation points. Identical calculation was performed for c_T and c_N. For a convergent process, following should be applicable:

$$\lim_{n\to\infty} \eta_{\%} = 0$$

However, if the limit starts converging only for large values of n (n>100), then the blade element method is time consuming and on par with more sophisticated analytical methods (3D paneling methods).

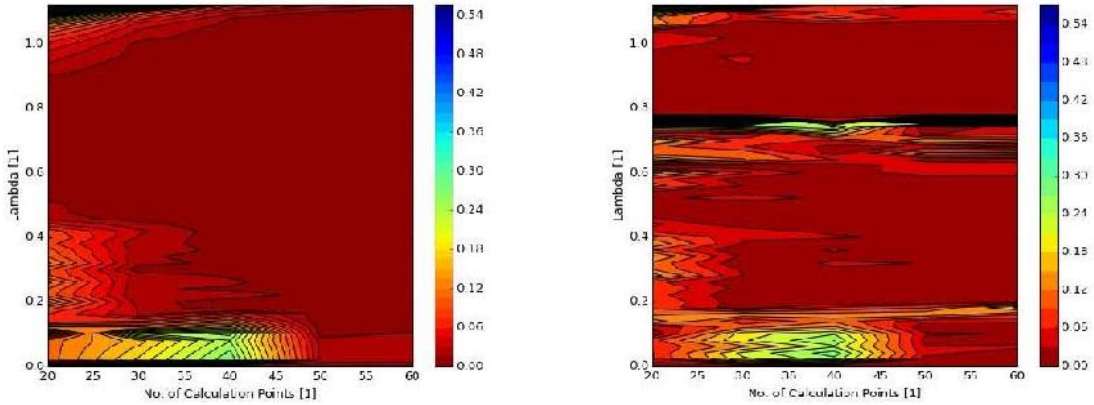

FIG. 3. Comparison of $\eta_{\%}$ calculated for second propeller. Joukowsky (left) and BEMT (right) (APCE)

Fig.7. displays values of $\eta_{\%}$ calculated for second geometry assumed. Both BEMT and Joukowsky method show considerable deviations for low values of , i.e. in static regime.

The apparent disruption of the BEMT result for between 0.6 and 0.8 was observed only for this particular geometry.

Further disruptions are observed at large values of for BEMT. This regime corresponds to the regime of zero thrust. Typically, the propeller aircraft can enter this zone only under very specific conditions (e.g. nose dive) and it is not important for calculation of a propeller performance. Figure 7. shows the worst results achieved – for other two geometries performed both methods more similar.

In order to determine the optimum amount of calculation points along the radius, the change of the calculated values compared to final (n = 60) was investigated as well:

$$\eta^{*}_{\%} = \eta_{n} - \eta_{60}[1]$$

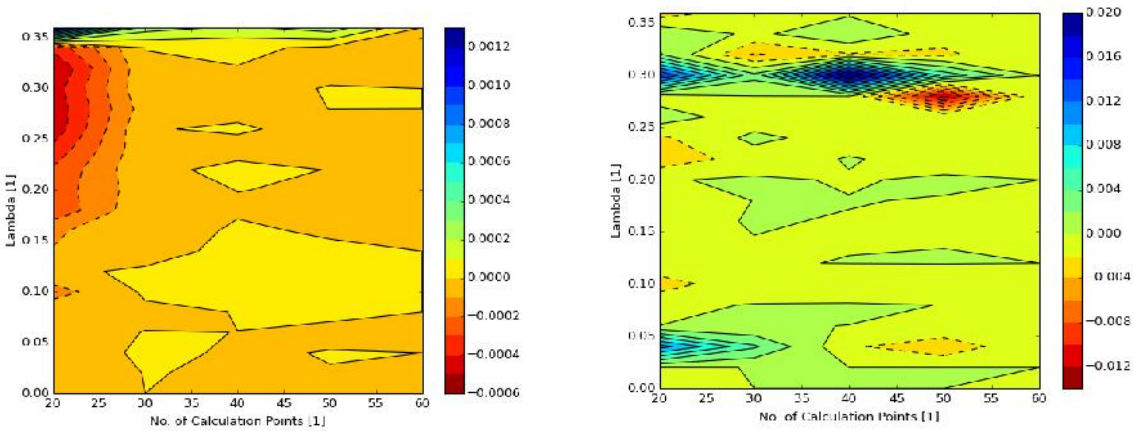

FIG. 4. Comparison of $\eta_{\%}$ calculated both for Joukowsky (left) and BEMT (right) (V509)

Figure 8. pictures the dependency of $\eta_{\%}$ on number of calculation points. The Joukowsky method performed considerably better even for as low as 20 calculation points. However, BEMT requires more calculation points to better approximate the results close to the maximum propeller efficiency.

6. CONCLUSION

The paper presents two blade element methods widely used to calculate the propeller performance. It explains in detail the differences in both implementations and then investigates the dependency of the solution obtained on the number of calculation points.

Considering the application of blade element methods in the initial phases of design of a new propeller, both versions perform exceptionally well. Nonetheless, for all examples tested, the Joukowsky method performs better and produces more stable solutions. Authors do recommend to check the solution by simply repeating the calculation again with larger amount of calculation points.

Both methods produce quick and precise results – however, a lot of calculation time is spent in the pre-processing phase, where airfoil polar for each blade section has to be calculated. For purposes of this paper, XFOIL was implemented into the program written marginally in LabVIEW and partially in MATLAB.

For this comparison, only axial flow was considered. However, both methods can be adjusted to implement also the yaw angle. In future, both the modification and the dependency of the solution on the azimuthal division will be presented.

7. ACKNOWLEDGEMENTS

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WING LIFT-DRAG RATIO OPTIMIZATION

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Abstract: *Many important performances are obtained in flight at maximum aerodynamic finesse, such as maximum endurance and maximum climb angle for jet-powered airplanes, maximum range of propeller-driven airplanes, maximum power-off glide ration (for both jet-powered airplanes or for propeller-driven airplanes. The Prandtl lifting-line theory (LLT) was used to calculate lift and drag for a wing, and optimum combination of twist and incidence angle was found to maximize the aerodynamic finesse.*

Keywords: *lifting-line theory, lift, drag, twist angle*

1. INTRODUCTION

Any airplane design starts with selection of the principal components. In this preliminary design, the geometrical dimensions are analyzed this the aerodynamics characteristics to find the suitable combination.

Airfoils shapes are designed to provide high lift values at low drag for given flight conditions. More parameters, such aspect ratio or taper ratio, influence the overall lift (L) and drag (D) of the wing. The Reynolds number is also very important for airfoil performance. This number determines the achievable section maximum lift coefficient and lift-to-drag ratio. It also bounds the maximum thickness-to-chord ratio, beyond which point the airfoil will have unacceptable performance. Airfoils provide two-dimensional lift, drag and pitch momentum, which is equivalent to the characteristics of a section of an infinite span wing. Real wings, the wing with finite span, behave quite differently.

Several theories were developed to estimate the wing aerodynamic proprieties and their distribution, like Prandtl lifting-line theory, vortex lattice method, Trefftz plane analysis, the panel methods or CFD.

The Prandtl lifting-line theory (LLT) predicts the lift distribution through a Fourier sine series. The idea of this method, also known as Lanchester–Prandtl wing theory [1], is that the vortex loses strength along the whole wingspan because it is shed as a vortex-sheet from the trailing edge, rather than just at the wing-tips. The advantage of this method is easy implementation, low computational effort and, the most important, satisfactory accuracy for numerous problems. The disadvantage is consists in single wing calculation, with some restrictions imposed to the wing geometry.

The vortex lattice method (VLM) permit the evaluation of more complex configurations than the LLT because include also wing sweep and dihedral angle into the model. Further details can be captured, like fuselage lift and side-force contributions or he downwash of the wing on the tail.

The Trefftz plane analysis theory evaluates the lift distribution in the Trefftz plane, the plane perpendicular to the direction of flight assumed to be at an infinite distance behind the airplane [2,3]. The advantages of this analysis method are the automatically determination of the optimal trimmed lift distribution for minimum induced drag at a given CL. The Trefftz plane analysis does not require knowledge of the elevator deflections, contrary to LLT and VLM who have to calculate the appropriate elevator deflections to ensure trim. But this theory does not determine how this optimal lift distribution is attained (if ever), it miss or give incomplete information for the angle of attack, twist and camber influence on the optimal lift distribution.

The panel methods splits the entire geometry of the airplane into rectangular panels. Typically, the fuselage outer mold line is divided into numerous panels around the perimeter and multiple segments along the length [4]. Also, the surfaces of wing and tail are paneled individually, rather than simply modeling the camber line with the VLM method.

The computational fluid dynamics method (CFD) suppose the calculus of the domain surrounding the aircraft. This domain is divided into volume elements, often with variable density, the greatest being where the greatest flow condition variation is expected. The method calculates the flow properties at every volume cell using inviscid Euler equations or viscous Navier–Stokes equations. The Euler method has a much faster run time, but is not capable of predicting drag directly. The absolute drag values produced by CFD must be carefully analyzed because the most codes do not predict transition from laminar to turbulent flow, and so the transition location must be input directly. Without a reliable method of determining the transition, the drag predictions are often unreliable.

2. THEORETICAL ASPECTS

If the infinite aspect ratio (two-dimensional) lift–incidence relation is linear [5]

$$C_{L,\infty} = f(\alpha_\infty) \tag{1}$$

The vortex structures trailing downstream of a finite wing produce an induced downwash field near the wing which can be characterized, according LLT theory, by an induced angle of attack (FIG. 1). For a finite aspect ratio, *AR*, with elliptic loading the induced incidence is

$$\alpha_i = \frac{C_L}{\pi AR} \tag{2}$$

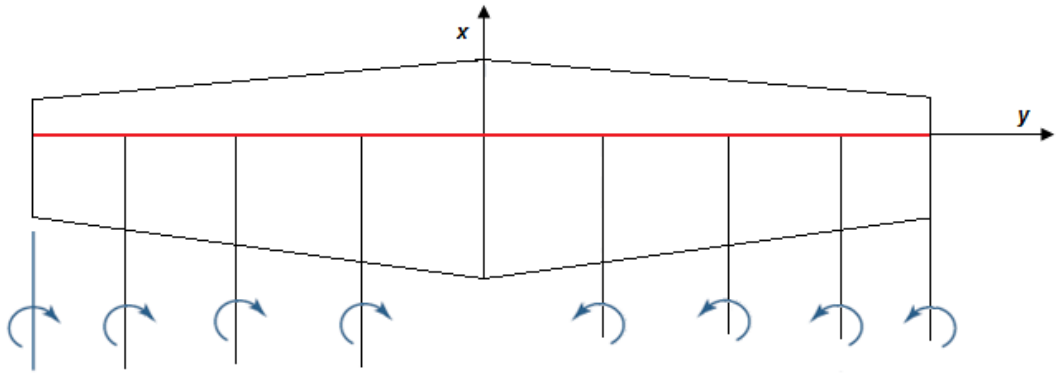


FIG. 1. Lifting-line horseshoe vortex representation

and at geometric incidence α the lift coefficient is that for the infinite aspect ratio at geometric incidence

$$\alpha_\infty = \alpha \quad - \alpha_i \tag{3}$$

So, if the wing is untwisted, the downwash and induced incidence are uniform along the span for the elliptic loading.

Taking account the induced incidence, the lift coefficient can be expressed by

$$C_L = \frac{a}{1 + \frac{a}{\pi AR}}(\alpha \quad - \alpha_0) \tag{4}$$

where *a* is the two-dimensional lift–incidence slope.

An elliptically loaded wing's induced drag coefficient is

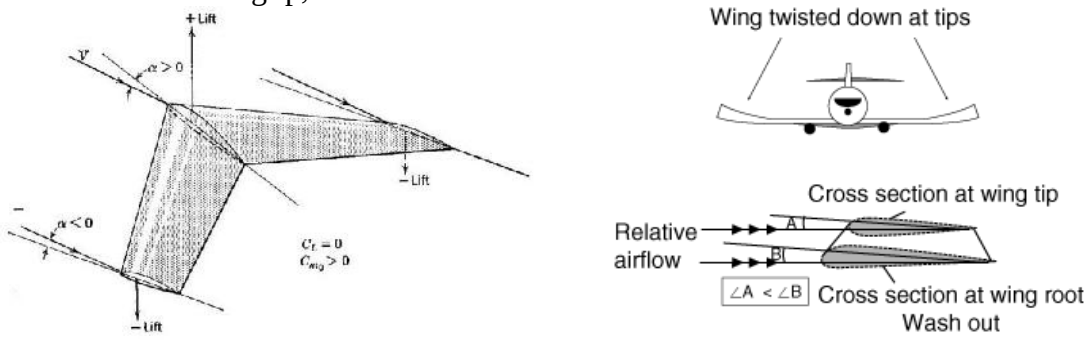
$$C_D = \frac{C_L^2}{\pi AR} \tag{5}$$

Practical wings are rarely constructed with an elliptic variation of chord length, since this is more expensive to manufacture than rectangular or trapezoidal planforms. Therefore. a corrected formula for untwisted unswept wings is used

$$C_D = \frac{C_L^2}{\pi eAR} \tag{6}$$

where *e* is an induced-drag factor which depends on the taper ratio and aspect ratio. The values of *e* are calculated (by LLT method, for example) or charted [6]. Anyway, the correction factor doesn't change the induced drag coefficient by more than about a tenth over the practical range of taper ratio and aspect ratio [7].

Most of real wings, mandatory for flying wings (FIG. 2a), have a twist angle over the span. That conduce to a lift redistribution to ensure the wing tip is the last part of the wing surface to stall. It means twisting the wingtip with a small amount downwards in relation to the rest of the wing. This ensures that the effective angle of attack is always lower at the wingtip than at the symmetry plane, so the root part will always stall before the tip part (FIG. 2b). This is because the aircraft's flight control surfaces, ailerons and flaps, are positioned at the wingtip, and we need those control surfaces to remain effective.



(a) (b)

FIG. 2. Wing twist concept (a) on a flying wing [8] (b), on an airplane [9]

3. MATHEMATICAL MODEL

The Prandtl lifting-line theory was selected as method for aerodynamic three dimensional wing identification [4,10]. Several reasons founded that selection. As already mentioned, speed of calculation and accuracy of results are some of method advantages. Also, the method is satisfactory for most aircraft configuration.

For example, despite the high degree of detail provided by the panel methods relative to LLT, in many practical cases, the number of panels required to analyze the aircraft is small and the advantage of the method vanish. More, since the target of this study is the wing alone, the LLT is the most appropriate for being used.

As derivation of the numerical lifting-line theory suitable for nonlinear lift-curve slopes [11], which is useful for analyzing wings near and beyond stall angle of attack, the present code is based on a matrix form was developed for subsonic applications [12].

The wing must meet the following criteria:

- The wing must have a negligible sweep (less than 10 degrees).
- The wing must have no dihedral.
- The wing must have at least moderate aspect ratio (more than 5).
- The flow is incompressible.
- The airfoils have linear lift-curve slopes and are not stalled.

The lifting-line method presented allows varied chord, camber, twist distributions along the span. The general formulation is

$$\frac{\pi c(\theta)}{2b}[\alpha + \alpha_{twist}(\theta) - \alpha_{0L}(\theta)]\sin(\theta) = \sum_{n=1}^{\infty} A_n \sin(n\theta)\left[\frac{\pi c(\theta) n}{2b} + \sin(\theta)\right] \tag{7}$$

where A_n = influence coefficient
b_w = wing span
c = chord
α = angle of attack
α_{twist} = washout angle
α_{0L} = zero-lift angle of attack of the airfoil

The angle θ is a parameter for the semispan ratio at a distance y from the wing root.

$$\theta = \cos^{-1}\left(-\frac{2y}{b}\right) \tag{8}$$

The twisted wing is split into N segments between 0 and $\pi/2$ radians, and n assumes odd integer values from 1 to $2N - 1$. The chord at the given θ, $c(\theta)$, is can be found through linear interpolation across the semispan.

The LLT conduct to the following matrix equation to be solved for **x**:

$$\mathbf{Ax} = \mathbf{b} \tag{9}$$

Where

$$\mathbf{A}(i,j) = \sin[n(j)\theta(i)]\left\{\frac{\pi c(i) n(j)}{2b} + \sin[\theta(i)]\right\} \tag{10}$$

$$\mathbf{b}(i) = \frac{\pi c(i)}{2b}[\alpha + \alpha_{twist}(i) - \alpha_{0L}(i)]\sin[\theta(i)] \tag{11}$$

The parameter $n(j) = 2\,j - 1$ and the indices i and j go from 1 to N.

Solving equation (5), the section lift coefficient at station i can be calculate by

$$C_L(i) = \frac{4b}{c(i)}\sum_{j=1}^{N} x(j)\sin[\theta(i)] \tag{12}$$

Finally, the total lift coefficient of the wing and the induced drag are:

$$C_L = \pi AR x(1) \tag{13}$$

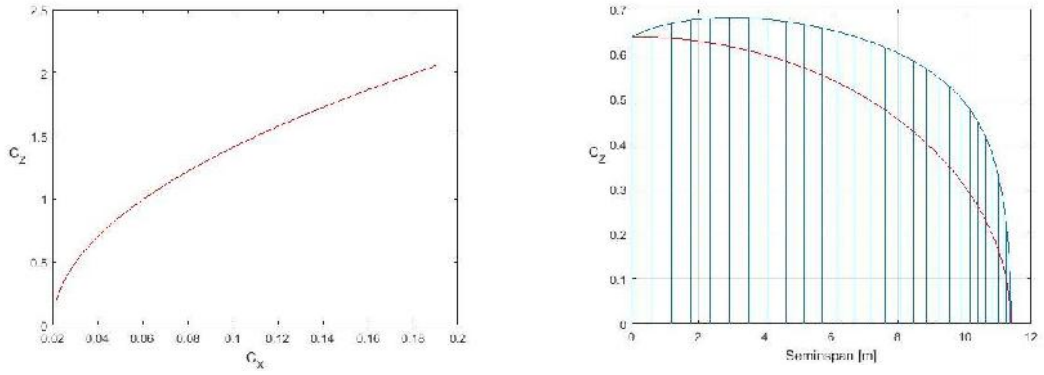
$$C_{Di} = \frac{C_L^2}{\pi e AR} \tag{14}$$

where $e = 1/\left\{1 + \sum_{j=2}^{N} n(j)[x(j)/x(1)]^2\right\}$ (15)

4. NUMERICAL RESULTS

A trapezoidal wing, with no sweep and dihedral angles and with constant twist over the span, was chosen for the analysis.

The LLT method was implemented into a MATLAB code in order to identify lift and drag for an aerodynamic surface. The first step was check the pertinence of results. A lift-drag diagram (FIG. 2a) was generated by varying the incidence angle. Also, the code permits to identify the lift variation over the span for -2 degree twist angle (FIG. 3b). Both variation are similar to theoretical results.



(a) (b)

FIG. 3. Code validation (a) Lift-Drag distribution, (b), Lift distribution over the wing

The geometric characteristics of the wing are taper ratio 0.25, aspect ratio 8 and surface aria of 65 m^2.

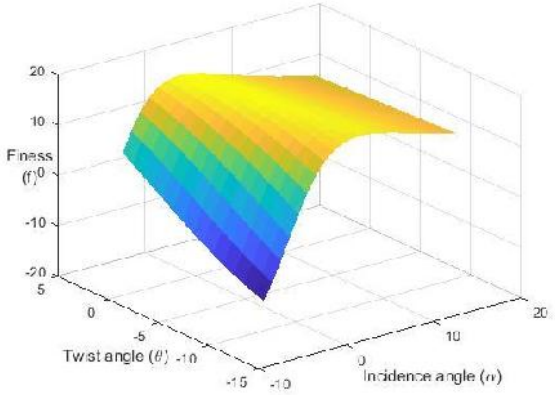
The airfoil aerodynamic characteristic of interest, the lift slope, is 6.9.

Since the aerodynamic finesse is the ratio between lift and drag, it is calculated as ratio between the coefficients found with LLT method ($f = C_L/C_D$). The Oswald coefficient calculated is also used into drag formulation.

Two parameters are chosen as variables: incidence angle and the twist angle. Should note that the constraint imposed to the twist angle is larger than the normal (in practice it is rarely over 5 degrees). The finesse is depending on those two parameters (FIG. 4).

An optimization problem is created in Matlab to find the maximum finesse. Since the optimization problems are minimum problem, the minimum of *–f* is searched.

Maximum value of the objective function is 17.67 and it is achieved at 6.23 incidence angle and 2.22 twist angle.



(a) (b)

FIG. 4. Lift-drag ratio (finesse) dependence on incidence angle and twist angle variation

5. CONCLUSIONS

One of the common constructive problems, the wing geometrical twist, is analyzed. It is difficult to vary the twist angle along the span, the practical solution is to use a constant angle. An optimum value is search in order to maximize the lift-drag ratio.

Matlab codes are use calculate lift and drag coefficients, to generate graphs and to create an optimization problem. Several methods (like Prandtl lifting-line theory, vortex lattice method, Trefftz plane analysis, the panel methods) was analyzed and LLT method was selected to be implemented.

The paper presents an easy and fast method of first level conceptual design. The method is useful to identify the basic parameters of an aerodynamic surface. Further detailed analysis should be made in order to obtain more refined results.

AKNOWLEDGMENT

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DISTRIBUTED COMMUNICATION AND CONTROL FOR MULTI-AGENT SYSTEMS: MICROINDUSTRIAL VEHICLE ROTORS (MAV)

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Abstract: *This paper main objective is the use of multi-agent systems to model micro-unmanned aerial vehicles (MAVs) for a distributed control load. We used a search scenario in the context of urban security and counter-terrorism. Using a simulation for autonomous MAVs, controlled by a neural network, the MAV must approach a target placed somewhere in the given environment and then detonate near it. First, we provide an overview of the latest generation of distributed control and communication in multi-agent systems. Afterword, the unmanned flight field from a historical perspective. Finally, we review the most relevant work on autonomous motorway planning. In the second part of the paper, we describe a simulation that includes a description of the developed MAV swirl simulator software. The results of the first set of simulations are general. The most appropriate set of sensors for neural network inputs, the evolved population of MAV swarms is capable of reaching and destroying the target on average 93% of the time.*

Keywords: *MAV, neuronal networks.*

1. INTRODUCTION

Distributed control is an interesting issue, hence from its technological and scientific view due to the synchronous movements that are necessary for coordination. In comparison with centralized control when an operator or leader establishes the plan and details the autonomous systems can easily resolve the issue and act immediately for the mission's success. Such systems require a partial interaction with other agents and small and simple data which are distributed around the world. These types of systems have a significant advantage due to the fact that they adapt instantly, without any mistakes, there is no time to waste for an answer from an operator, thus the speed of reaction increases dramatically, and there is no re-planification needed.

Adaptive solutions can appear anytime through the interaction between autonomous systems and the intelligence request which is not fully know at the beginning of the mission.

Studies regarding distributed control usually use Multi-Agent Systems (MAS) because it can simulate and test different platforms based on artificial intelligence. [1]

The MAS methods have been in used in wide area of domains such as UAV (unmanned aerial vehicles), terrestrial vehicles, search and save, social knowledge, etc. Some researches such as Sastry and others concentrated on subaquatic systems (Eklud, [2]); Sykara (Koes, [3]) concentrated on hybrid systems for search and rescue based on humans, software's and autonomous robots. What I propose is the use of coordination architecture capable of finding fast solutions for all the issues that appear, planification for mission regroup and if the system is restrained due to multiple threats.

In the project SWARM-BOT, Baldassarre [4], the group of robots Trianni and Dorigo [5] develop a common cooperation strategy for exploration. The distributed coordination control is not managed by one operator or a leader, it is the result of auto-organization, for example positive feedback. Eventually, there have been proposed a diversity of MAS models such as those which study the behavior with animals, ant colonies and the predator group behavior.

An important issue that was not studied directly in the distributed control MAS is that of communication between agents and people in hybrid systems.

Most MAS models consider communication typically and they refer to implicit forms of communication. For example, visual clues in predatory models and communication in colonies. These communications can be of the most value in tasks that require higher-level cognitive capabilities: planning and decision-making, as well as the integration of cognitive and language skills.

New studies as explicit communication has many implants. First, agencies that are authorized to communicate explicitly during the execution of a collaborative task could benefit from the exchange of information on the characteristics of the task being processed.

Thus, explicit communication systems cannot be defined by the humans but can emerge from the social interaction between agents. Another advantage of studying symbolic communication concerns the development of human killing systems and a human / robot / human hybrid system.

Finally, post-hoc analysis of the communications systems developed by agents can provide a meaningful insight into the best strategies. This can also be used to design and improve control systems distributed to humans.

2. UNMANNED AERIAL VEHICLE (UAV): GENERAL PRESENTATION

First of all, it is crucial to define the description of unmanned aerial vehicle, also known as a UAV. To do so, we will adopt the definition provided by the Military and Associated Military and Associated Dictionaries Dictionary [W1], which states: „A powered vehicle that does not carry a human operator, uses aerodynamic forces to secure the lifting of the vehicle, it can fly autonomously or can be remotely piloted, extendable or recoverable and carry a lethal or non-lethal task. Semi ballistic, cruise missiles and artillery missiles are not considered unmanned aerial vehicles".

An advantage for using UAVs instead of traditional crewed aircraft are to avoid human loss and, in the same time, increase the chances of success for their missions. In fact, as Cambon and colleagues [W2] report, unmanned aerial vehicles are commonly used in so-called "dull, dirty and dangerous" missions. The "boring factor" is easy to understand: during long and repetitive missions a car could offer a better alert status compared to a person, improving the overall success probability for the mission.

The "dirty" aspect is related to the tasks where the danger comes not from the enemy, but from another source. For instance, despite the fact that they wore lead-fitting suits and the plane was shattered at landing, American pilots who flew data collection missions on the Pacific Bikini Atoll immediately after the 1946 nuclear tests suffered a radiation illness. Ultimately, the "dangerous" factor could be both physical and political.

Physical, if we consider that a crewed aircraft exposes pilots to any kind of risk, especially during reconnaissance missions. Political, if we consider the issues of capturing a person. Some sources, for example, link the American built unmanned aerial vehicles with the U-2 spy plane shot while flying over the Soviet Union sky during May 1960 and the subsequent capture of its pilot, Francis Gary Powers, by the Russians.

Driving the so-called "U-2 crisis," this event clearly demonstrated to US governors how it was not politically acceptable to capture a pilot by the enemy during the Cold War.

In recent years, due to the rapid improvements in technology, a new category of UAV has emerged. These are called micro-unmanned aerial vehicles (MAVs), properly known as Class I UAVs, as defined by the US Army [W3], which states:

The Unmanned Aerial Vehicle of Class I (UAV) offers the soldier dismantled with the Recognition, Surveillance and Acquisition Target (RSTA). Estimated weight is less than 41 pounds, the air vehicle operates in complex urban and woodland land controlled by dismantled soldiers. The aircraft can also be equipped with EO / IR / LD / LRF capacity to carry out the RSTA mission and use a heavy fuel engine (HFE) as a propulsion system.

Class I uses flight and autonomous navigation but will interact with the operator's network to dynamically update the targeted routes and information. Sometimes it provides assistance for early recognition and warning. It will also realize a limited relay to communicate in limited field action. The system (which includes an air carrier, control device and ground support equipment) is packed in the rear.

The MAS category is, in fact, only the natural result of the evolution of the UAV that have taken place over the last decades. They, became smaller and lighter than their predecessors, reaching true points of excellence. Consider, for example, the MC2 EPFL, a 5-gram fixed wing aircraft made of carbon fibers and thin films Mylar [6] [7] or MicroGlider developed by Wood and colleagues [8].

Even if we are now faced with a race to the most extreme forms of miniaturization, we already have reached a point where MAS can be successfully applied to innovative tasks. [9]

3. AUTONOMOUS PLANNING OF UAV / MAVS

The fact that an aircraft is not capable of transporting human pilots directly implies that it must be conducted in a different way. Nowadays,the UAVs that are currently used in real application scenarios are being controlleddynamically from a distance by a human crew that is in a remote position using a Tactical Control Station (TCS). Using multiple UAVs, at the same time, means that they must have their own guidance systems.These guidance systems are slightly similar to autopilot used in civil aviation, as they simply provide the UAV with a certain plannedroute.

Focusing on autonomous guidance systems is not just an economic issue, even if the use of robots flying instead of the usual "crew plane plus the human pilot" would save the enormous amount of money needed to prepare pilots. The idea is that a computer program can usually exceed a man in carrying out many different tasks, both in terms of reliability and accuracy.

The issue currently stated is that a human pilot is limited when we think of driving a bunch of MAS in city environment. To be capable of controlling various members of the party from a remote position means to be able to manage an infinite flow of information that enters the TCS every second and to answer properly. The flow of information is incomparably higher than that usually received by a pilot driving a Predator several kilometers above sea level. It is virtually impossible for a man to manage all this data that comes from the field. This is actually impossible if we want to hire dozens of MAS and move them like a real swarm. This is the main reason for increasing the interest in autonomous robotics.

According to Richards and colleagues [10], the current approaches to autonomous control of UAV cooperation can be divided into several different groups:

• deliberative approach: focused on developing a specific flight path for each UAV to follow. Such flight paths are rigid and no effort is made to modify them if new information is received (such as the discovery of a hostile element in a war environment).

• the adaptable replanning approach: To achieve certain degrees of flexibility, some deliberative systems include an adaptive re-planning element. In adaptive replanning, a centralized controller generates a specific flight path for each UAV to follow based on currently available information. The UAV follows that flight path by sending sensor information back to the controller as it becomes available. As the controller receives new information, it can generate new flight paths that are transmitted back to the UAVs. New plans may, for example, consider locating an unknown previously unknown enemy or that a UAV was lost due to a mechanical failure or for many other reasons.

• Reactive strategies: rather than generating a specific flight path that needs to be updated during missions, this approach tends to generate a so-called "reactive strategy" for each UAV.

In the aforementioned paper by Richards et al., Where a UAV team has to cooperatively explore a particular area, the decision tree that controls the various aircraft is developed through genetic programming methodologies. Even if the main idea - according to the controller system cannot be something outside the UAVs but needs to be incorporated - could be fully agreed, a more convenient approach could be to use evolving evolutionary neural networks (Parisi et al., Noli and Parisi, Floreano and Mattiussi, Mitchell), mainly for two reasons. First, it's easier to use neural networks instead of GPs for this type of task, because the behavioral deposit you give to MAVs is much simpler. Second, if properly trained, neural networks allow a much larger generalization capacity than a decision tree that evolved through genetic programming.

However, in both cases, a computer simulation is needed for cost and time reasons (for an overview of the importance of simulations in modern science, see Casti [11], Parisi [12], Cecconi and Zappacosta [13]). Developed strategies need to be evaluated in the simulated environment because the evolutionary process potentially requires thousands of evaluations of the strategy to converge on effective solutions.

Neural networks are commonly used in terrestrial and underwater robotics, but very rarely as control systems for flying robots. The main exception to date, the review of literature, is the work that Floreano and colleagues [14] [15] carry out at EPFL. Their project is focused on hiring fully autonomous MAVs where each member of the roi acts as a signal repeater to create a secure communication infrastructure between human rescuers and the base station working in areas affected by natural disasters. At the same time, Owen Holland and his research group [16] [17] are studying how to use neural networks as controllers for autonomous helicopters.

Finally, even if this approach falls within the adapted re-planning category, other significant insights come from the work carried out within the Autonomous Flight Systems Laboratory at the University of Washington. Emphasizing the importance of using heterogeneous autonomous systems instead of traditional hierarchical structures, Rathbun and Capozzi [18] have developed an efficient route planning algorithm for situations where UAVs have to modify their paths to avoid a range of other flying aircraft near.

4. CONCLUSSIONS

In this paper we have showed how a neural network controller for MAVs can be successfully developed using a computer simulation based on evolutionary algorithms.

With a more realistic environment, we could add to the MAV's behavior a social dimension. Thus, replacing the target with a more robust one that needs two contemporary hits to be destroyed.

Another direction would be to increase the number of MAV members belonging to a swarm and vary the starting points. This way, we will be able to develop a true swarm behavior. After we can suggest the use of non-cloned MAVs, individual characteristics (such as would be, for example, a preferred direction to be followed when approaching prey).

Gradually, the aim is to move on to a more realistic scenario. We will use a three-dimensional environment that contains objects characterized by real physical properties.

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FUZZY MULTI CRITERIAL SELECTION FOR PROMETHEUS DECISIONS IN MILITARY APPLICATIONS

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Abstract: *This paper formulates the selection of solid information as a multi-criterion decision-making issue and presents a fuzzy intuitionist multicriterial decision modeling model for the efficient resolution of the problem. The subjectivity and imprecision of the decision-making process is adequately addressed using fuzzy intuitionist numbers. The concept of ideal solutions for determining the overall performance of each solid waste disposal alternative is adopted in all selection criteria. As a result, effective decisions can be made as to the choice of the most appropriate information on the specifics of the mission. An example is shown that shows that the proposed decision model is simple and effective to solve the problem of selection in real world settings.*

Keywords: *UAV, CSR, ISTAR,CAA, anti-drone system*

CAA	*- Civil Aviation Authority*	*ISM*	*- Industrial, Scientific, Medical*
RSSI	*- Received Signal Strength Indicator*	*UCAV*	*- Unmanned Combat Aerial Vehicle*
FMCW	*- Frequency Modulated Continuous Wave*	*ISTAR*	*-Information, Surveillance, target acquisition, and Reconnaissance*
SIGINT	*- Signal Intelligence*	*IR*	*- InfraRed*

1. INTRODUCTION

1.1 History

In the last decade, there has been a rapid growth on the unmanned aerial vehicles (UAVs) market. Around 80 countries possess UAVs, from which less than a dozen can be armed, according to the Ministry of Defense. According to the US General Accounting Office e the number of countries with UAVs has increased from around 41 in 2004 to 76 countries in 2012. These Unmanned aerial vehicles (UAVs), are commonly called drones, are aircraft or remote-pilot systems. The range is simple: short-range systems and long-range high-strength systems which require an access road. UAVs have civil and commercial uses, but this work also has an interest in the military role. They can also be called unmanned aerial systems (UAS) and remote-pilot aircraft (RPA). Their main role is Aerospace Research, Surveillance and Recognition (CSR) or Intelligence, Surveillance, Acquisition and Target Recovery (ISTAR). The only United Kingdom armed UAV is Reaper and is used only in Afghanistan. Under the 2010 Strategic and Security Strategy (SDSR), the Government has promised to invest in a fleet of UAVs in combat and recognition roles.

Increased use of UAVs and their use by the United States in Afghanistan, Pakistan and elsewhere raises a number of moral, ethical and legal issues. Remote pilots operate on the same operating rules as crewed aircraft. There is no completely autonomous UAV. [3], [34]

1.2 Strengths and weaknesses

The unmanned aerial vehicles (UAVs) possess advantages and disadvantages as crewed airplanes. UAVs contribute to reducing the risk for airplanes operating in hostile territory. Such systems can be used for "dull, dirty and dangerous" objectives. These can be cost-effective and offer significant information, surveillance and recognition capabilities. This may help to inhibit the ability of the enemy to move in secret. UAVs are more consumable than crewed airplanes, at least in terms of lives, if not in money. Also, a lot of deficiencies - currently lacking the flexibility and adaptability of crew equipped aircraft, and more advanced systems require a greater or more cumbersome requirement than crewed aircraft.

A note of the Joint Defense Ministry's doctrine suggests that "if current trends continue, it is likely that the cost of unmanned complex aircraft will increase to convert rapidly to those of crewed aircraft." The large amount of data provided by the UAV will always require advance technology in automated data to ensure the use of collected information.

But let's not forget the vulnerability to data transmission interference. There will also be restrictions regarding the operation area, especially in civil airspace.

Most analyzes of the use of UAVs share concerns about the legal, moral and ethical issues they raise.

For Romanian armed forces, UAVs will have a greater impact on the Air Force than on other services, as they will be used to fulfill their core function, aerial surveillance and early warning. The army and the navy could use UAVs to "allow them better to deliver their terrestrial or maritime power." [4], [35]

1.3 Restrictions of UAVs in airspace

All remote pilots (UAVs) are treated as military aircraft and subject to the same regulations as aircraft on board. The complete guide on the use of UAVs is in the Civil Aviation Authority (CAA) manual.

In the United Kingdom, unmanned aerial vehicles (UAVS) are allowed to fly only in separate airspace, restricted airspace (temporarily) and in hazardous areas. This is because none of the UAVs currently in operation is equipped with an approved "sense and ability to allow" them to operate in civilian airspace.

The Civil Aviation Authority provides the following definitions:

Sense-and-Avoid is a generic term used to describe a system that involves one or more sensors that is capable of seeing, sensing or detecting traffic or other conflicting dangers, and taking appropriate action to in accordance with the applicable rules. In this way, the system acts as a substitute for seeing and avoiding crewed airplanes.

Separate airspace, as the name suggests, is an airspace block specifically dedicated to the flight of an unmanned airplane. Collision risks are eliminated by strictly preventing or controlling access to this airspace by other aircraft.

2. MULTICRITERAL ANALYSIS (ADVANTAGES, DISADVANTAGES)

2.1 Introduction

Strategic decisions have been described as an "important in terms of actions taken, committed resources or previous sets".

Strategic decisions are "decisions rarely encountered by top leaders of an organization which critically affect organizational health and survival". In addition, the creating, evaluation and implementation process for strategic decisions is generally characterized by taking into account the high risk and the potential synergies between the different options. Long-term consequences and the need for stakeholders to engage in meaningful psychological and social negotiations are absolutely necessary.

A recent trend within organizations is to engage in strategy workshops such as an effective means of engaging in strategic decision-making and ensuring the participation of key actors in the process. A recent Hodgkinson study proved that Multi-Criteria Decision Analysis (MCDA) are barely used to support strategy workshops. This is somewhat surprising because simplified forms of MCDA - where the model is created directly with a group of managers in a decision-making conference - seems to be a perfect tool to support strategic decisions in a work shop.

We believe that alternative MCDA methods can be useful to support a strategy team in charge of design and high value selection for strategic options. However, its use in workshops may be caused by limitations in the MCDA approach, which may make it inefficient to support strategic decisions and the processes in which they are created, debated and evaluated.

We therefore propose a series of changes so that it can be implemented as an effective tool in supporting strategic decisions. Changes will require consideration of both technical and social aspects. The purpose of this chapter is to suggest these changes and to create a framework for using MCDA. To support strategic decision making in strategic workshops, we illustrate these changes with examples of real-world interventions. Strategic decision-makers were involved here.

2.2 Multiple objectives

In the literature, there is sufficient evidence on the transparency of multiple objectives in the strategic decision-making process (eg [18]). The fact that strategic decisions usually involve taking into account several strategic objectives suggests the adoption of the MCDA as a tool for assessing strategic choices. The benefits of scenario planning, combined with MCDA ratings, provide a set of tools that support strategic decisions. Since the 1980s, the use of MCDA for scenario planning has been considered. Most work uses multi-attribute value analysis, such as Goodwin and Wright [25]. However, other MCDA methods may be used [14].

At a theoretical level, Belton and Stewart discussed the use of MCDA and scenario planning. Stewart presented some technical aspects related to this integration and offered a proposal on how it could be done. Montibeller et al. suggested a framework for analyzing multiple attributes. These attributes will be in several scenarios, such as Belton and Stewart, but with emphasis on robustness of strategies.

An important change that some organizations may have is when they use MCDAs based on values that guide the decision-making process. In this case, strategies are seen as means to achieve the organization's strategic goals. This can help both align the strategic vision of the organization with strategic objectives and take strategic options into account. (see [6]).

Therefore, a key issue in supporting strategic decisions is the need to help define and structure them. As presented in recent research [10], people are usually trying to think about the fundamental objectives they need to take into account when making a decision. While managers have a profound understanding of their organizations and think about what they want to achieve, our experience with management teams shows that they usually do not have a clear framework for thinking about decisions.

Consequently, it is reasonable to argue that they need invariably support in defining and negotiating objectives that are considered important and essential in a certain strategic decision context [17].

A variety of tools can be used to structure goals, such as network goals, causal / cognitive maps, workshops, etc. We have used cognitive maps on a large scale - a network of decision-makers who want to reach them and the means they have. Links show the perceived influence - to support the structural objectives and the value of the trees. This is a particularly useful tool because the final structure of the means allows the analyst to value the values of the decision-makers. After setting decision makers, it sets the fundamental and strategic objectives, contributing to the structuring of a value tree (for a discussion of how they can be used to see Montibeller and Belton). There are other applications of cognitive maps for this purpose reported in the literature, e.g., Belton et al. [7], Bana e Costa et al. [5], Ensslin et al. [19], Montibeller et al.

For example, we helped a British Planning and Performance Team (PP team) in identifying strategic goals. The process was supported by a cognitive map that was developed interactively with team members using the Grup Explorer network system (www.phrontis.com) (a set of wirelessly connected laptops) running along the mapping software decision for Explorer (www.banxia.com). These mapping tools allow team members to introduce and structure ideas in "real time".

2.3 Design robust options

Much of the MCDA literature was the evaluation of the options, with a predefined set of alternatives. Although it is an important aspect of many decisions, our experience has shown us that most decisions - especially those at the strategic level - do not start from a well-defined set of options. As Keeney has pointed out, designing better options is a crucial aspect of successful decision support.

We used large-scale cognitive maps to generate options. An example would be the above-mentioned municipal council project, for each strategic objective we asked the group members to generate a list of options. This list of options was then introduced through their laptops and presented in the cognitive map projected on the public display. In this way, we had a brainstorming focused on achieving the strategic objectives of the organization.

The next support an analyst can offer is to create better options. Indeed, the key advantage of using MCDA comes from specifying and measuring the achievement of strategic goals of the organization. In this way, it is easy to determine the weaknesses and strengths of each strategy.

Analysts can then help customers think about ways to reopen options, improve weaknesses, and assess marginal value. Not only an inter-scenario robustness should be an objective, but also an inter-scenario risk, the latter being a concern in reducing performance variability.

2.4 Long term considerations

Most of the MCDA applications reported in the literature present the results from a single point of view and that attempts to represent the performance of an option if implemented.

Particularly, in taking strategic decisions, we must take into account the long-term consequences.

A relatively simple way to take into account long-term consequences in these cases is by applying a time reduction as in the current net worth (NPV) analysis. A key challenge of VNA analysis is always to define an adequate update rate. In private companies, this can be relatively simple because it is related to the cost of capital.

However, the same cannot be said about public decisions where the level of updating is questionable - a high rate can make long-term costs negligible and favor the short term [23]. Another pathway, recently suggested by Santos is the use of system dynamic models to simulate multiple system responses, considering policies as inputs. These responses can be used as policy performance in an MCDA model.

3. MCDA FOR MAKING STRATEGIC DECISIONS: FACILITATING THE PROCESS

In the previous sections we discussed several ways to describe the technical complexity associated with strategic decisions. The main focus will be on designing decision support processes to address the social issues. In association with strategic decision-making we will propose easy decision-making as an effective way to provide this support.

Using "easy decision modeling" to describe a process through models will develop a strategy team, in real time and with or without the help of the computer (Eden, 1990; Franco and Montibeller, Phillips 2007). A decision model is "formal" if it is a strategic decision-making issue rather than a relation to cause-to-effect relationships or relationships between decision-making and their consequences (deterministic or uncertain). A formal decision model is accepted for analysis and manipulation, but not necessarily quantifiable. The decision model produced in an easy manner is used by the members of the strategy team as a "transient object" [16, 13]. It will allow them to share their strategic concerns and increase their individual understanding of strategic issues, assessing the potential impact of different strategic choices, and negotiating strategic actions that are feasible.

When the members of a strategy team take part in an easier modeling process, they are engaged in "conversations" [22] to change their views on the strategic decision. This process is participatory in the sense that team members can make strategic decisions, understand and develop and evaluate a portfolio of strategic decision options. This process is supported by the decision analyst both as a facilitator and as a modeling engineer [2].

Because interaction between decision-makers and stakeholders is needed with decision-makers, in order to be able to build together a strategic decision model, modeling is also an interactive process. Such interactive processes continue until the situation is structured and analyzed in a satisfactory manner. The group must feel sufficiently confident about the commitments and implementation options in order to be able to address them in an acceptable manner.

Modeling is usually organized in clustered stages, which generally correspond to: the development of a model of organizational objectives; creating, refining and evaluating options; developing an action plan. However, decision stages need not be followed in a linear succession, but rather, the participants can move between stages.

From a technological point of view, modeling of decision-makers cannot be a sophisticated activity that calls for a workshop and does not necessarily require software to support it [3]. Simple modeling can also be implemented with the help of your computer. In this case, specialized software is used to support processes [1]. This type of software allows rapid model creation and real-time computation [3].

Some programs, such as Group Explorer (www.banxia.com) and VISA Groupware (www.simul8.com/products/visagroup.htm), allow participants to directly and anonymously submit their views on a decision-making issue.

Then the system is operated by a modeling engineer who analyzes the data according to the group's wishes. Once a decision model is built and stored in the system, multiple analyzes can be performed.

The previous discussions clarify that the modeling of the decision-making facility differs from the standard modeling of decisions. This requires a decision analyst capable of supporting a process of building group models. Group models must be participative, interactive, scenic, nonlinear, and supported by appropriate technology. And at the same time, the decision maker and his approach must respond to the dynamics of group work and the particularities of the situation [57]. The next section explores the continuation of what is needed to become a decision maker.

Facilitated decision model

As has already been said, the modeling of decision-making facilities requires the decision-maker to act as a facilitator in the process of modeling and analyzing group decisions. This means that the decision analyst must be prepared to use general facilitation skills as part of his modeling work. Based on the general facilitation literature and Schuman and others we consider three basic facilitating skills necessary to model decision making facilities:

• Active listening requires that the decision analyst can clarify, develop, summarize and refine participants' contributions by paraphrasing and / or reflecting what the participants say; validating what they say without judging;

• Managing group dynamics is probably one of the most fundamental skills for the facilitated modeller. By facilitating active listening, the decision analyst must be able to identify when the difficult dynamic of the group occurs during modeling and be treated as group situations that must be treated supportively. The difficult dynamics of the group also require the decision analyst to know if, how and why to intervene during the modeling process.

• Closure is a key skill that a facilitated decision maker uses to help the group reach out on the way forward. This assumes that the decision analyst identifies when the group has reached a point, from "playing" to the decision model, requiring closure to a proposal, and reaching a required decision model [55].

4. CONCLUSIONS AND PROPOSALS

The multi-criteria decision analysis (MCDA) has been widely used to support highly complex decisions. The MCDA has been used in both public and private organizations. We believe there is an excellent opportunity for MCDA to support strategic workshops. Given their usefulness nowadays, in these workshops, organizations shape their strategic vision, develop strategic options, and evaluate strategic choices.

In this paper we proposed a framework to use the multi-criteria decision analysis to support strategic decision-making in workshops. The framework is from our practice as decision makers in giving strategic decision support to a wide range.

There are two main issues to be addressed by the decision-maker if we want to support strategic decision-making processes. The first would be to related the content issues, particularly with regard to uncertainty, multiple organizational goals and complex policies. The key issue is the development of robust strategies against multiple scenarios. The second aspect would be related to the process, in particular being an active listener. Dealing with group dynamics and helping the group to reach its goal is a key factor in realizing the objective.

We acknowledge that further research on this issue needs to be carried out, which could allow for further development of this framework. In particular, we suggest the following directions for further research:

• Robustness - Several studies on the robustness of strategic options are required in several scenarios;

• The design of complex policies - the structure of policies composed of interconnected options is an almost unexplored area.

• Long-term consequences - this is an area open to research by MCDA, and developments in other areas.

• Impact of decision-making on the strategy process - there are already some systematic research on the impact of the decision-making conference on the group's results; given the special nature of the strategy workshops, it would be interesting to assess the impact of the framework.

Given the importance of the strategic decision-making process for the survival of any organization, further developments in this area could not only bring research opportunities to the various challenges I have outlined here, but also have a real impact on MCDA practice.

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MATHEMATICAL SIMULTATION IN OBTAIN SOME SPECIAL METALLIC STRUCTURES

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Abstract: *This paper aims to present the mathematical simulation in obtain some special metallic structures who are obtained using unconventional process.*

Due to the lately development in composite materials, the paper aims to analyze the influence of certain technological factors, and optimizing the processes that occurring.

Keywords: *metallic structures, unconventional process.*

1. INTRODUCTION

The technology development has imposed increasing demands on choice of materials special purpose in obtaining new classes of materials with special properties.

The purpose of this paper is to present the technologically obtain layered metallic materials whose production by using nonconventional methods are applicable in the aircraft, chemical and defense industry.

2. THE TECHNOLOGICAL PROCESS SIMULATION

One of the methods for preparing composite structures for special equipment, is the explosive cladding. The technological process is based on the conversion the kinetic energy resulting from the detonation the explosive charge at the interface of the welding heat, which leads to the interface plate and thus melting the welding thereof [4].

The metal diffusion takes place gradually, and it is influenced by the structure of the plates to be welded and the distance between them.

The principle is illustrated using the data from the mathematical modeling of this phenomenon. Following the explosive charge detonation, will form an angle of collision between the plates due to plasma jet resulted melting interface boards.

However, both the thickness and physical and mechanical properties of the plates will not be affected.

After bringing the plates to dimensions that are intended to be coated and their positioning for welding - by separating them by spacers - the entire surface of the top plate will be placed the explosive in a box made of a material that will destroy the load at the time of detonation so that its presence does not affect the structure of the plated material.

Spacers are only designed to create the optimum distance between the plates to be welded. [3]

In **FIG. 1** shows the 2D finite element model simulating the mounting, in order to plating.

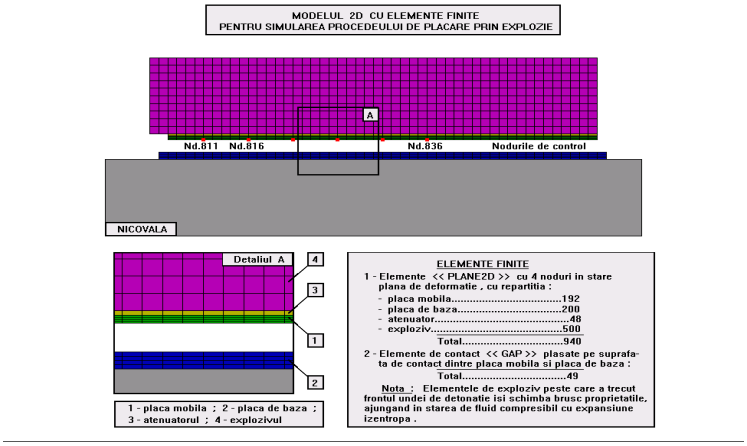

FIG. 1. The 2D Finite Element Model from the simulated Explosion Welding Process.

For the explosive welding process to take place, the following basic requirements must be met, namely: the emergence of the jet at the interface and to obtain a contact pressure allowing stable development of interatomic links [1].

The speed of the detonation wave propagation is influenced by the density of the medium.

In **FIG.2** is presented the mathematical simulation of technological process sequential plating explosion at different times. [2].

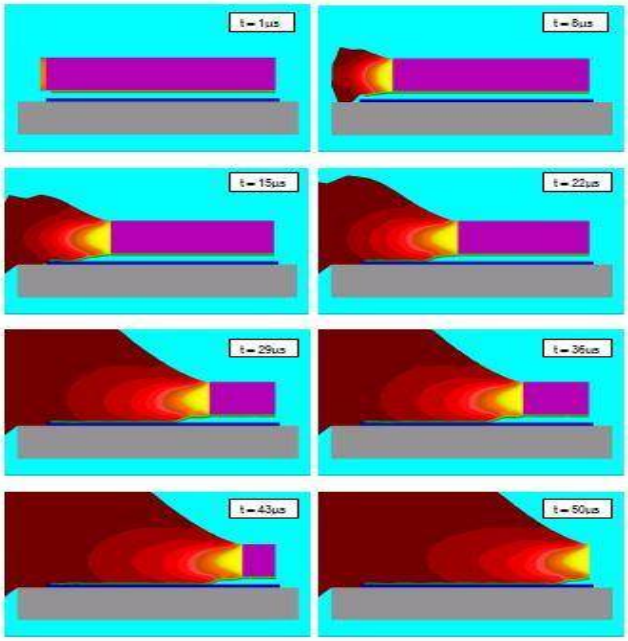

FIG. 2. Sequential stages from the welding explosive process.

Front collision product, as they get clean the contact surface will then, because the pressure, to achieve welding plates. This welding connection is characterized at the structural material overlap by a plate, in section, the contact surface having an undulating character.

In this way, the plate can be welded having a surface area of up to 30 m^2 and a thickness ranging from 0,025 mm to 1000 mm.

The velocity field of fittings, are represented in **FIG. 3**.

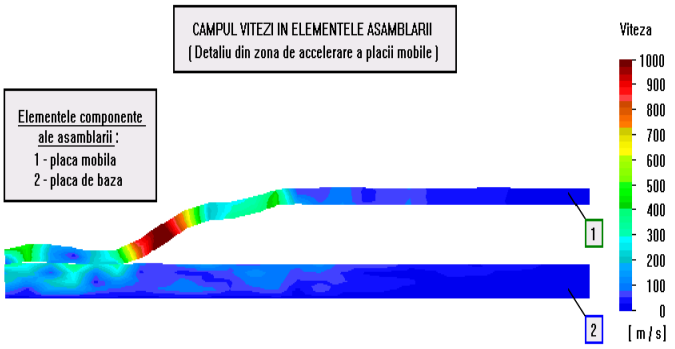

FIG. 3. The speed's field in the assembly elements: 1- the movable plate; 2- the basic plate.

FIG. 4 present the mobile plate moving and the dynamic angle collision on this unconventional process by welding plates.

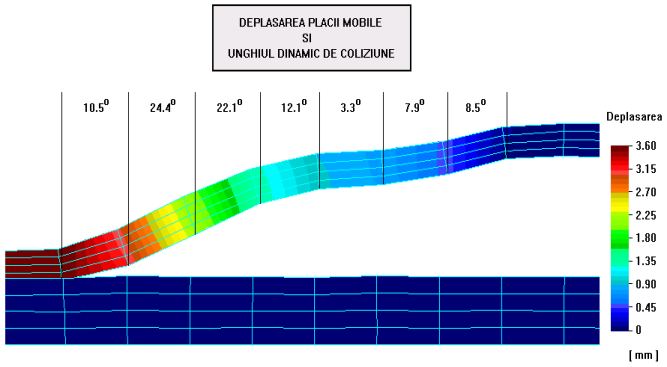

FIG. 4. The mobile plate moving and the dynamic angle collision.

Besides the beneficial effects of explosive cladding technology in **FIG. 5**, some imperfections due to the quality and coated surfaces can be observed.

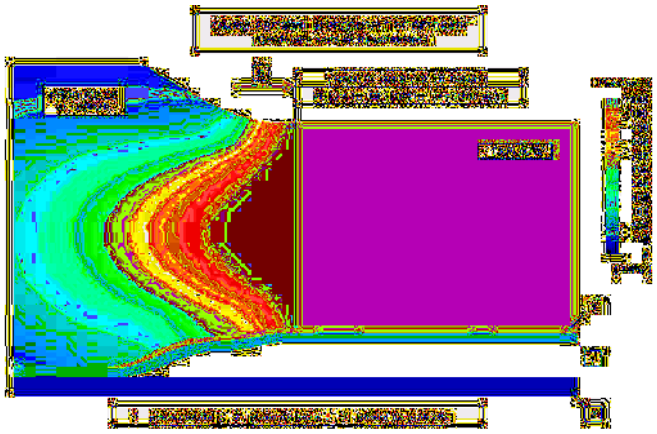

FIG. 5. Presure field in detonation products: D - the detonation wave front;
1- the movable plate; 2- the basic plate; 3- the protect layer.

CONCLUSIONS

Of the submitted work emerges the importance of using technological methods in obtained unconventional structures with special properties for the top civilian and military technology.

The simulate using the finite element method, the unconventional plating by explosion technology, aimed at highlighting the advantages of applying such a process technology due to its simplicity and the fact that the internal structure of the component materials is not affected.

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BOUNDARIES BETWEEN THEORY AND PRACTICE IN ASSESSING THE SCIENTIFIC RESEARCH IMPACT

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Abstract: *This approach would identify and transmit at the level of university, the boundaries between theory and practice in impact assessment of scientific research projects. That study proposes to analyze the actual level of impact assessment and give a personal interpretation of Ben LEVINE Analysis Model of the Research Impact theory in the mining's of military and civilian research programs.*

1. INTRODUCTION

In one way or another, assessment of the impact is, in its basic form, a process of identifying future outcomes of a current or future action, respectively, the relation cause-effect found in Physics-Mechanics [2].

Nevertheless, assessment of impact represents an essential practical aspect for the normal functioning of systems, in general, whereas, in particular, it represents the self-regulating action of the feed-back type in modeling systems while considering quality and durability of the output.

2. DEFINITION

When assessing impact in an academic manner and while studying the two related terms, "assessment" and "impact", we reach common grounds with regard to the general aspect that may be expressed by the two terms individually. "Impact", within the definition, suggests and implies a cause-effect relation in the future, as well as some capacity of forecasting changes in the future status, with or without an intended action. Still, since changes in status cannot be predicted accurately, assessment of impact implies the identification and management of risks, uncertainties and vulnerabilities to which a self-regulating system is subjected [3].

In broad terms the definition of "impact" is ample and it contains a diversity of potential future actions under the appearance probability of some effects upon a system or general phenomenon or the appearance of some effects upon a narrow array of environment conditions (Fig.1).

NET IMPACT OF ACTION	=	TOTAL OF CHANGES	-	CHANGES EXCLUSIVELY DUE TO ENVIRONMENT

FIG. 1.

The "assessment" side of the definition may be very general and it can be limited only by the identification of future outcomes or it can include a series of specific activities, it being precise enough in analysis.

Assessment of the impact is a key element of national development policies for most of the European Union countries. One of the reasons of such concerns, at national level and at the European Union's level, is represented by the responsibility of all European Union member states to assure transparency and equity in assessment processes and financial resources allocation at the European Union's level.

In a general context, without particularizing various aspects, the impact assessment process involves the interested parties and the affected ones that take part in and influence, to various degrees, the run of the process and its results.

Due to the fact that the impact assessment is a key element of the national development policies, we identify the political side as holding a passive role in the impact assessment at the national level, within the national policies, and a proactive role influencing the social and political context in decision making.

In this context, the scientific research impact assessment plays a major role, a proactive and final one within the assessment process of the new educational and research policies, at national level and at the level of the European Union.

In order to complete the education-research correlation, a top education system requires a high level of scientific research, based on quality, quantity and easily transferable know-how at the social level.

Taking all the above mentioned into account, the scientific research assessment is a determining element of the scientific research and development policies at national level and at the level of the European Union, as well as an essential practice for the well functioning of the research and development system.

The assessment of the scientific research impact has, in its general acceptance offered by specialists, two main functions:

- the orienting or managerial function;
- the results validation or performance improvement function. Usually, this function is unidirectional and focused on validating results or on improving performance. Some other times, we can meet combinations of the two functions in one single financing instrument.

At the level of military university scientific research, the analysis of impact represents the managerial instrument for quantitative and qualitative analysis of scientific research results or for in-depth research for the development or making of new products and strategies.

3. APROACH FOR MILITARY CDI

The nature of research, development and innovation in the military higher-education scientific research is given by the niche-segment of this type of organization. Similarly, the use of high-end technologies and the development of new techniques in research, development and innovation, in accordance with the new defense approach policies within the NATO and the EU, place the military higher-education scientific research at the top of the research, development and innovation instruments.

Within the Romanian Armed Forces, this is achievable by means of two parallel ways, both at the level of Higher-Education Institutions and Research, Development and Innovation Institutes belonging to the MoND, and at the practical/applicative level, offered by the Directorate for Technology and Procurement Programs.

The collaboration between the Directorate for Technology and Procurement Programs, as the major programs director, the categories of forces, as beneficiaries of the need for research and the military academies belonging to the categories of forces, as supporters of the scientific research, is beneficial and answers the external stimuli on the military technology market as well as the needs for re-technologization of the Ministry of National Defense. Together with producing research, research implementation within the assimilation process of new technologies represents another context of the research impact.

Many organizations, among which the military organizations as well, have a limited ability of presenting the results of any research that is efficient, given its orientation toward internal goals well established through governmental policies and international ones. The organizational opacity of the "military" type is given by the reduced interface with the consumption society (a niche characteristic) or by the national security policies.

The impact of a Research-Development Paper is only quantifiable at the moment when its ideas and solutions offered through prototypes testing are applied into practice, at testing and product-homologation centers belonging to the MoND or when its final solutions are integrated into product usage manuals by the categories of forces or at the strategic level.

The development of impact analysis models is beneficial especially for the military research system, which is based on closed matrices and algorithms of the input or output types at the level of know-how transfer.

4. BEN LEVINE ANALYSE MODEL

An impact analysis model has been produced by Ben LEVINE[3]. This model is based on the analysis of four main elements of a status model, as follows:

-research production status (academic and university-applicative);

-research implementation status (regional policies and stages for project implementation);

-social context status (prejudices and preoccupations);

-mediators (media and professional nets of the cluster type).

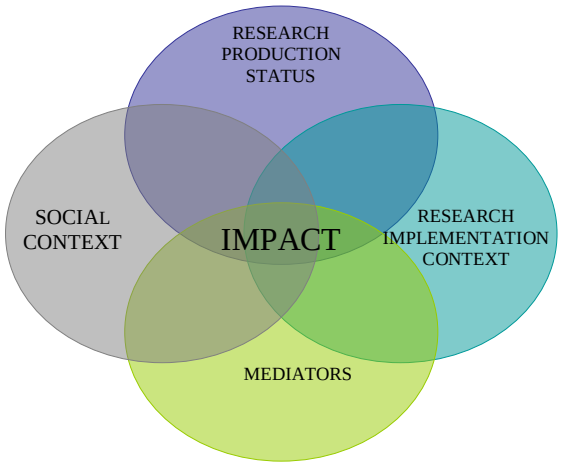

FIG. 2. Ben LEVINE Analysis Model of the Research Impact

This research impact analysis model, proposed by Levine may lead to the increase and improvement of scientific production through a greater attention given to impact, on behalf of researchers and practitioners as well.

There are several directions to be followed, according to Levine, such as:

-grants distribution through impact assessment will be achieved after researchers are demanded to make precise specifications with regard to their research dissemination;

-possible strategies and models for assuring the impact;

-strengthening the potential beneficiaries' input through the development and re-thinking of research proposals;

-use of existing research and its use as a starting point for new studies by exploiting data and research outcomes more technically;

-intellectual networking between researchers sharing common goals.

The use of Levine Model within the Ministry of National Defense is a desiderate to be achieved for the improvement of research quality through maximum exploitment of intellectual and material resources and for the creation of a background for obtaining remarkable and scalable result, both in the laboratory research and within the academic research.

The new strategic projections in the area of defense, at the European Union and NATO levels will be applied into practice using the existing intellectual resource, combined with the need for research, for finding alternative solutions and for disseminating them at the level of the categories of forces.

The relationship with the economic dimension of the new strategic projections will be achieved much more easily through an analysis of the impact and sustainability of the grant, in the actual geopolitical and economic context.

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ASPECTS ON A CUBESAT PROJECT

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Abstract: *This research focuses on the design of the nacelle and CubeSat and their structural analysis. The innovative design is well aligned with the objectives of the multifunctional platform, generically named STRATOTEST, as well as with the current research trends in this field. Therefore the use of composite materials, PLA materials and their 3D printing comes as no surprise in order to build a robust and durable structure..*

Keywords: *CubeSat, stratosphere, structure design*

1. INTRODUCTION

STRATOTEST is the acronym for a project that proposes the development of a multi-functional platform (for astronomical research, flight and ground testing of aerospace industry systems and materials and added educational value by providing access to master and PhD students to the „ close to" space environment. The main objective of the project is industrial development speed growth in the aerospace sector and growth of the research capabilities of small enterprises and of the two partner educational and research institutions. STRATOTEST project circumscribes to the Romanian Space Agency and Romanian organizations efforts for the creation of new assets adapted to European Space Agency's specific programs Technology Science Support (TSS) and Space Situational Awareness (S.S.A.)

CubeSat is a concept derived from micro satellites research that has been embraced by all the aerospace researchers whom adapted the concept to other similar uses. Its cubic shape and its modularity offer mor flexibility in the design process and a higher redundancy by means of other unit task allocation Once the tasks are redistributed, the failure of one cubesat will not mean the mission has also failed [1].

2. CUBESAT STANDARD AND DESIGN

The paper focuses on the design of the nacelle and a CubeSat and its structural analysis. The accepted standard for a CubeSat unit is 100x100x100mm, the equivalent volume of a litre. Beyond this is the design freedom of each engineer under the constrains of the project.

The material selection process is highly important to the structural design of the CubeSat as it effects the design parameters such as weight, strength, rigidity, thermal conductivity, as well as construction variables such as manufacturing capability, reproductability and last but not least, cost effectiveness.

As the nacelle containing 3 CubeSat units will be launched via a weather balloon to the stratosphere, the takeoff weight estimate of 5 kg gave way to the structural design of a CubSat 3U (3 unit CubSat) with the Solidworks software.

The next step that followed was a numerical simulation. Using Ansys as a software environment and the finite element method as the numerical method, the CubeSat was structurally analyzed to see if the concept structure can withstand the loads and stresses its suppose to in its flight and most of all, throughout its landing.

After CAD tailoring and design of the structure the chosen materials were as follows: for the nacelle the *Al 6061*, a high strength aluminum alloy with very good material properties, often used in the aerospace industry; for the CubSat unit *carbon fiber composite side panels* connected on *PLA 3D printed struts* that are also fitted for the electronic onboard components (Fig. 1)

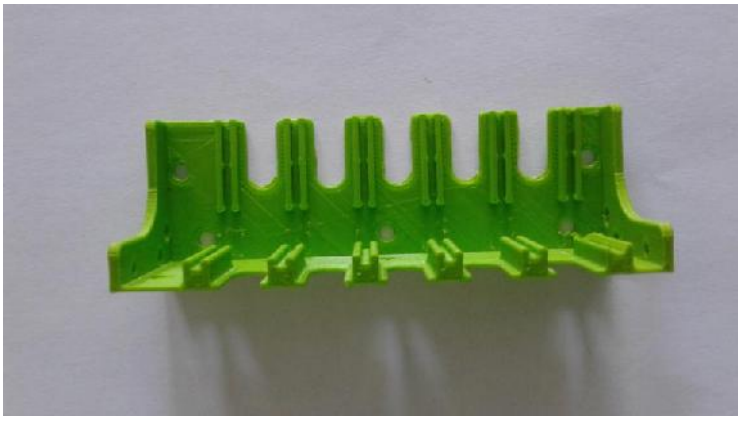

FIG. 1 3D printed PLA frame strut with configurable slots for electronic circuit boards

The design specifications for the CubeSat unit, that represent constraints and requirements kept in mind throughout the entire process are presented below, with the note that not all the recommendations made by the Nasa Goddard Space Flight Center [3] were considered as the flight will only be limited to the stratosphere.

Mechanical constraints were:

- All the structural elements and assemblies must remain fixed and immobile during the flight mission;
- High risk materials will not be used in the manufacturing of the CubeSat;
- Each CubeSat unit fully equipped with electronics will not weigh less than 1 kg;
- The center of mass for the equipped nacelle will be within a virtual 4,5 cm distance away from the geometric center;
- For the nacelle frame anodized aluminum alloy AA6061 will be used, because it has standardized properties unanimously accepted in the aerospace industry;
- The contact between the nacelle and the CubeSat must be made with minimum tolerances,
- The overall dimensions of the CubeSat unit in the xY plane must be 100+-0.1mm and on the Z axis 110+-0.3mm,
- Not one of the electronic or mechanical components onboard must exceed 1cm measured from the surface of the CubeSat.
- The nacelle structure must be at least 3mm thick, to ensure structure safety upon landing ;

The choice of materials is an important step in designing the nacelle, because the weight is a factor in determining the maximum altitude and also because the small structure alterations can offer valuable space for onboard components. The environment plays a significant role in the choice of materials as well, therefore:

- The thermal expansion coefficient of the CubeSat has to be the same with the one of the nacelle.
- The yield strenght of the material has to be higher than the numerically determined maximum von Misses stress in order for the material not to deform under the loads.
- The material has to be easy to manufacture
- The material has to be of low density to minimize the overall weight
- The volatility of the material and its components has to be kept to a minimum,
- The material has to have a minimum out-gassing; [3]

Table 1 below shows the material characteristics of the aluminum alloy selected for use in the nacelle's structure frame.

Table 1. Material characteristics of AA6061

Mechanical Properties		Thermal Properties	
Brinell (Hb500)	96	Specific heat coefficient	0.896
Yield strenght	310MPa	Thermal conductivity (W/m-K)	167
Point yield	276 MPa	Melting temperature	582-652
Elasticity modulus	68.9GPa		
Poisson's ratio	0.33		
Strength fatigue	96.5MPa		
Machinability	50%		
Shear strength	207MPa		

For the nacelle and CubeSat shell we opted for carbon fiber composite materials custom designed panels. This choice offers many benefits out of which the main one can be the possibility of designing the strength characteristics of the material according to the directions were the loads will be prevalent.

The carbon fiber we selected is a 160g/m^2 twill woven together with Epiphen 4020 epoxy resin and the specific hardener in 30g to 100g proportion. The technology employed for the manufacturing of the composite plates involves standard manual lamination techniques, vacuum infusion and a standard 20^{o}C 24h curing process. Due to the known issue that manual lamination techniques can determine poor quality parts, mainly because of the high ratio of resin to the carbon fiber in the part, the vacuum infusion was selected in detriment of higher cost.

All the onboard electronics are placed on circuitboards that need to be imobile, cooled and protected from potential damage. For all those reasons a custom design printed PLA frame was designed and printed.(fig 1) This material has a quality that is considered necesary for unstandardized parts and specific to the exploratory research that is printability, that offers options for other configurations on a cost effective basis. PLA material characteristics allow its use in space [4], as well as the stratosphere. According to [4] the procentage of mass loss is 0.56% out off 1% that is admited for space applications.

Designing a modular three unit CubeSat nacelle that is easily assembled and reconfigurable was an innovative process. The solution offers the needed flexibilitySoluţia oferă flexibilitatea necesară ingineril to develop more applications and to test them as a full system. More specific the position of the subsystems can be modified and new configurations can be acomplished according to the new missions specifics, without the need to redesign the nacelles structure.

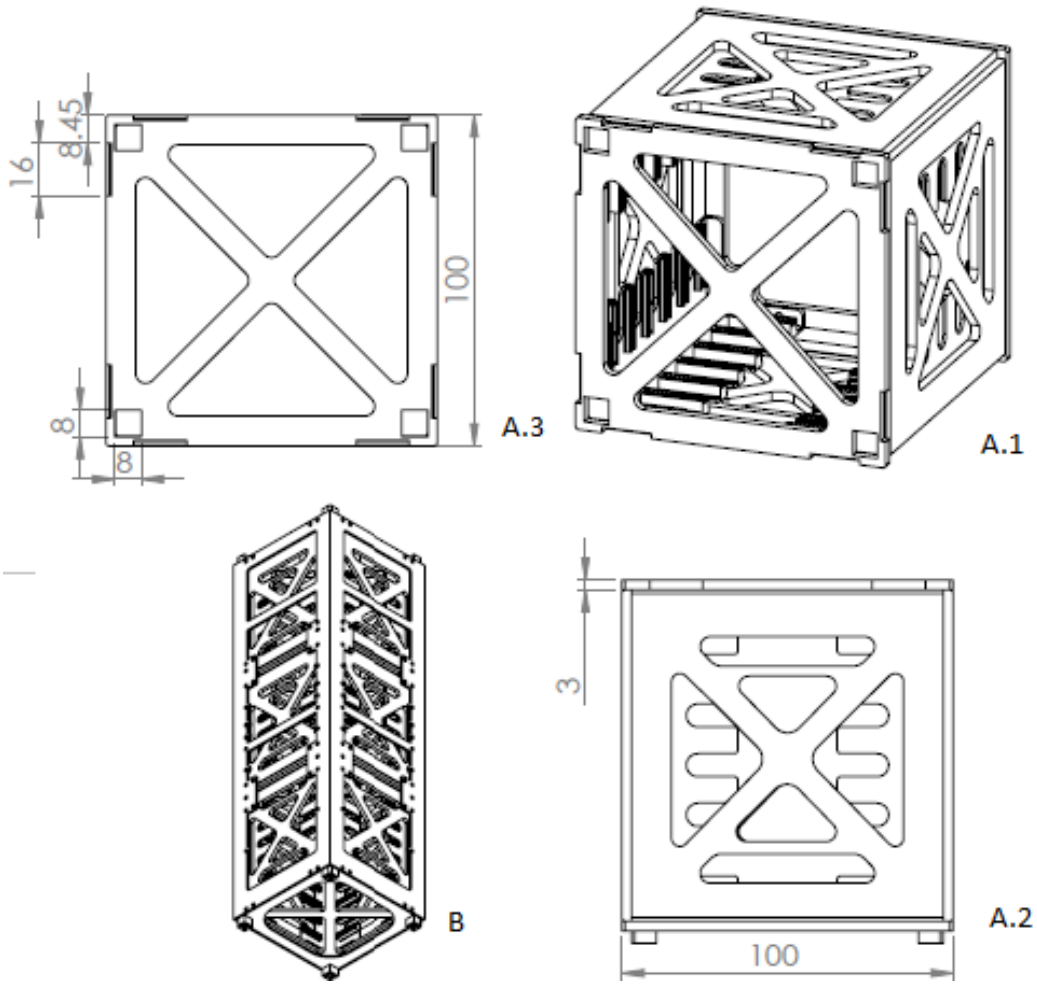

FIG. 2. Nacelle and CubeSat structures. A.1 Isometric view of a CubeSat unit A.2 Side view of the CubeSat unit with dimensions of the composite side panels(thickness and width) A.3 Top view of the CubeSat unit with the given dimensions for protruding legs of PLA structure(8x8mm) B. Nacelle isometric view

The nacelles and CubeSat's dimensions was determined by following the standards and constrains in [5]. Solidworks was the choice software for computer design, as Ansys was used for material characteristic implementation, weight estimation and mass center determination.

4. NUMERICAL EVALUATION

Once designed in Solidworks, the CAD model was exported towards Ansys as a compatible file for the static analysis. The loadings and constraints were set after the nacelle was meshed with tetra elements acording to the specifics of the finite element method. The virtual loadings set on the nacelle model were set to 200N, 300N and 500N as distributed loads on one side of the frame, while the other side was fixed.

The first step of the static analysis was done with more than three times the possible load in order to set safety measures for potential unforseen problems on the landing. The second step was meshing the frame. Tetra elements with the maximum dimension of 1mm, in total more than 148000 meaning more than 300 thousand nodes were used (Fig 3).

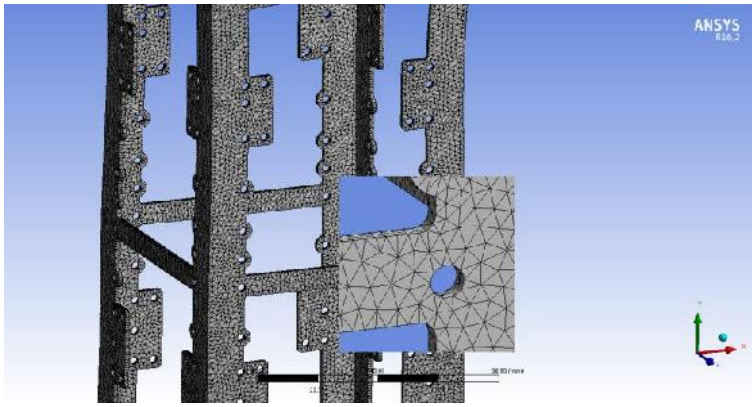

FIG. 3 Meshing of the Nacelle with detail on a rivet hole meshing

For the meshing of the carbon fible composite side panels of the CubeSat triangular elements were also used with the maximum width of 0.8mm generating more than 40000 nodes. The figure below shows the mesh and the measures that were taken in designing the side wall as not allow any sharp corners that could concentrate stress.

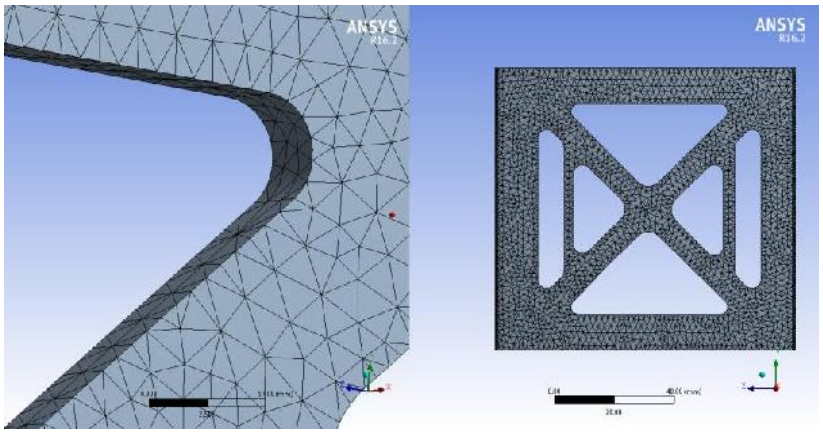

FIG. 4. The meshing of the side composite panels with details on the rounded corners

Another relevant case study considered was imposing a point force on one corner of the frame, to account in some measure for the forces developed in case of low hight ground impact. This was the second solution tested. The value of the forces and pressures applied was the same as presented before, 200N, 300N and 500N.

The maximum obtained displacements obtained for a uniform loading of 500N, on one of the nacelle basis was $84x10^{-4}$, and for the same point force, positioned on a base corner was of $63x10^{-3}$. The figure below (fig 5) presents with a standard code of colors the stress on the structure for the first test case and then figure 6 shows the stress for the top corner loading case.

5. CONCLUSIONS

This paper presents the conceptual design and static structural testing of a type 3 nacelle, able to house three standard CubeSat units. A new design for the CubeSat unit is also proposed, with panels out of carbonfibre composite materials and frame suport from 3D printed PLA material. The nacelle has a suficient volume for all the CubeSat units and is made out of aluminum alloy AA6061.

Professional design and simulation softwares were used to determine the strenght characteristics of the nacelle and CubeSat. SolidWorks was employed for CAD modelling and Ansys for the static analysis with the finite element method.

Through design calculations and numerical validation the maximum allowed weight of the unequiped structure will be of 1 kg. Therefore the computed maximum stresses of (aprox 20MPa) will be much smaler than the yielding stress of 274MPa the aluminum alloy AA6061 offering the needed safety of the structure. The maximum strains of $9x10^{-3}$ mm shows that the loads acting on the structure on this test case induce a small amout of deformation in comparison with the structures thickness of 9mm, therefore the structure will resist even three times that load.(fig 5 and 6)

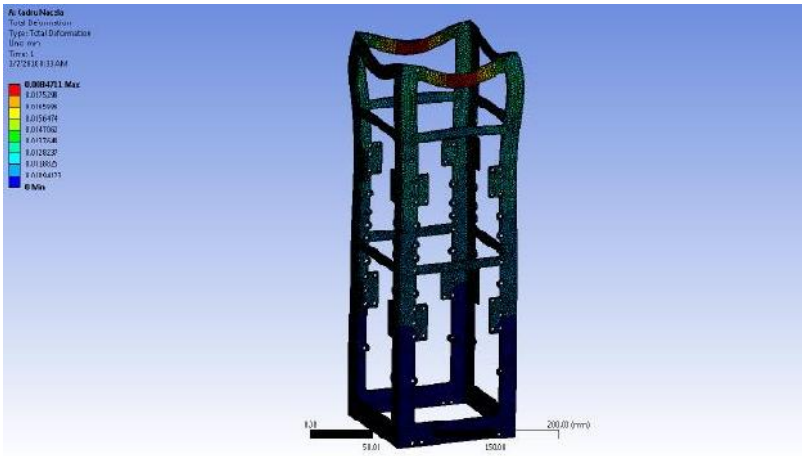

FIG. 5 The numerical solution for the deformation on the nacelle after the 500 N loading

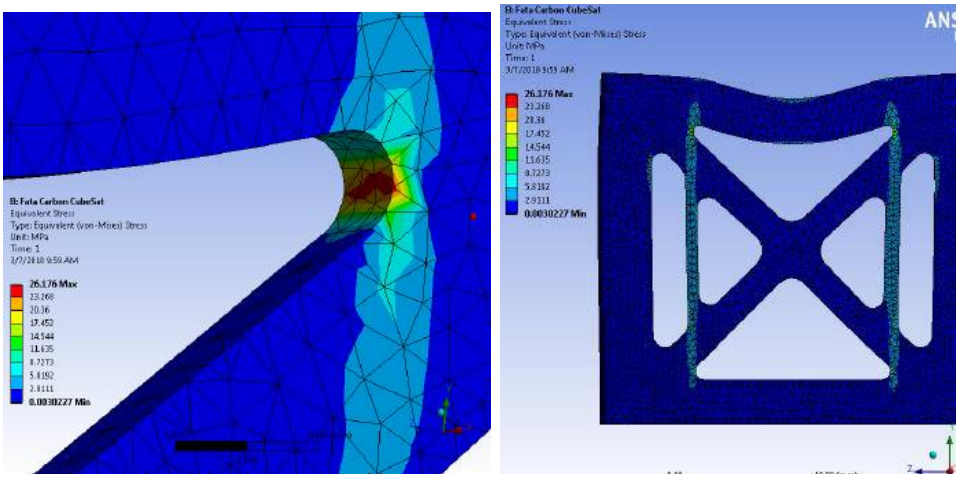

FIG. 6. Stress distribution on the carbon fibre composite plates after 500N loading

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FLIGHT PERFORMANCES ANALYSIS OF UAV MFD NIMBUS

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Abstract: *Low cost, fixed wing UAVs have become available for a series of missions aimed to acquire data and operation information at entry and middle level. The concepts of fixed wing mini-UAVs make a necessity for users to have a proper knowledge regarding the flight and operation performances, in order to select the best type of aircraft for the required mission.*

The article contains a series of flight performances analyses for MFD Nimbus including 2D airfoil and 3D wing analyses, but without considering aerodynamic interferences between wing-fuselage-tail.

Keywords: *aerodynamic analyzes, MFD Nimbus, FPV, XFLR5*

Symbols and acronyms

FPV	*First-Person Viewing*	*AoA*	*Angle of Attack*
VLM	*Vortex Lattice Method*	*AR*	*Aspect Ratio*
LLT	*Lifting Line Theory*	*MAC*	*Main Aerodynamic Chord*
V	*Air speed*	*GPL*	*General Public License*
TE / LE	*Trailing Edge / Leading Edge*	*BL*	*Boundary Layer*
GUI	*Graphical User Interface*	X_{CP}	*Pressure center position*
C_m	*Pitch moment coefficient*	*Re*	*Reynolds number*
C_L	*Lifting coefficient*	C_Y	*Lateral force coefficient*
C_D	*Drag coefficient*		

1. INTRODUCTION

Nimbus is an aircraft UAV manufactured by MFD (MyFlyDream). It features a V tail, two electrical engines on a rectangular wing. The front part of the fuselage is removable, thus allowing for the mounting of radio-electronic equipment, while the rear part of the body is made out of carbon. It is designed to be assembled and to be transported quickly, therefore all its body parts are made as simple as possible [1, 2].

FIG. 1 MyFlyDream Nimbus

Constructive features and radio-electronic equipment offer the capabilities of a UAV that can perform low-cost missions in the FPV concept used to acquire data in areas of interest in accordance with national law.

Table 1. Technical features, [1, 2]

Parameter	Value	Parameter	Value
Span / lenght	1800 mm / 1300 mm	Max. speed	130 km/h
Lift surface	37.5 dm^2	Endurance	1,5 .. 2,5 h
Max weight / Payload	5,5 kg / 1,5 kg	Max. ceiling	3500 m

The wide array of missions the Nimbus can perform are as follows: acquiring of data (both image and telemetric) which can be transmitted through the airborne radio equipment (GPS), of data regarding the atmosphere using its environmental sensors (temperature and humidity) and of data related to 3D behavior of the frame in its flight. The behavior of its structure is also recorded by mounted sensors (vibrations, twisting etc).

2. XFLR5 THEORETICAL GUIDELINES

XFLR5 is software featuring a wide range of geometrical modules (foil, wing, tail, fuselage, and aircraft) and of functions for aerodynamic computing (methods VLM, LLT and 3D panel) at GPL standards for the designing of sailplanes, a task for which the software will bear reasonable and consistent results.

Analysis algorithm used by XFLR5 it the same used by XFOIL and it makes possible a direct analysis using its own airfoils database. The airfoil is defined by: name, Reynolds and Mach numbers, transition point of turning from laminar to turbulent flow, upper and lower surfaces; figure 2, [3].

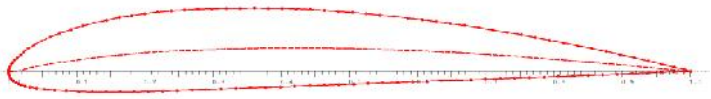
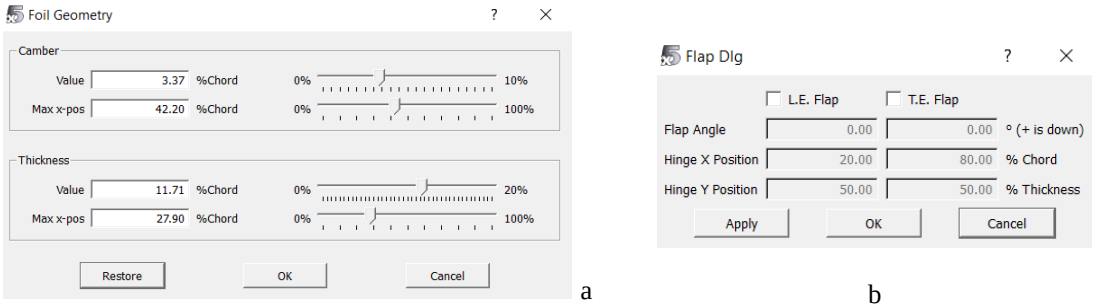


FIG. 2 Clark Y airfoil

2.1. 2D theoretical analysis

The 2D geometrical module contains functions for import/geometrical editing of a reliable airfoil and allows the user to configure the geometrical parameters of the foil such as: normalization; global and local refinement; editing the foil coordinates; camber and thickness of the airfoil the deflection of leading /trailing edge control surfaces fig. 3.



a b

FIG. 3 2D geometric module XFLR5, a. chamber and thickness, b. flap [3]

A direct analysis of the airfoil contains: a numerical evaluation module for a specific Reynolds number, two series of numerical evaluation modules for an interval of Reynolds number values, one function to reset the computing data; an XFOIL module for the initial phase of the computing and a visualization function for the computational journal.

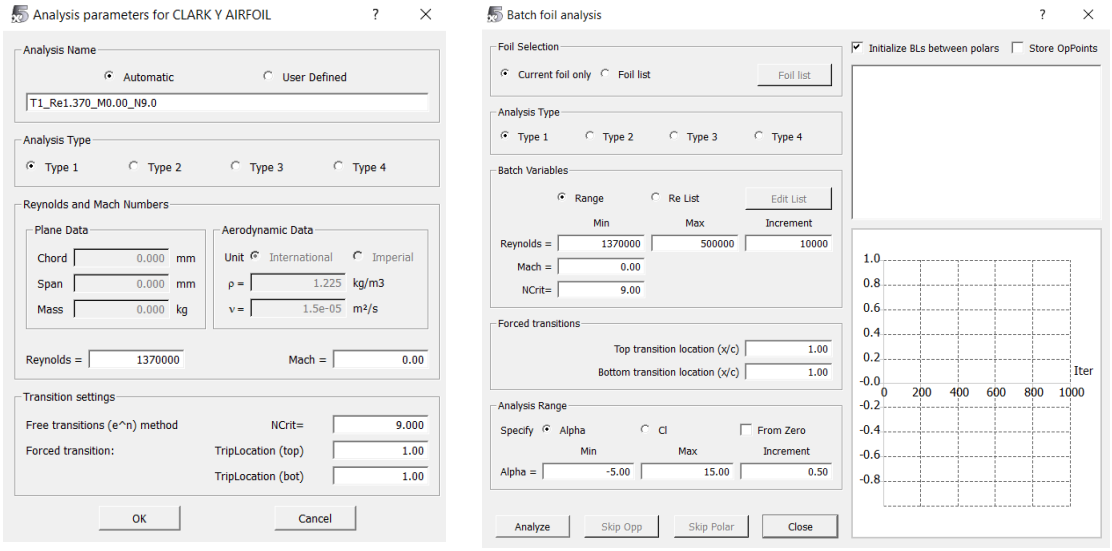


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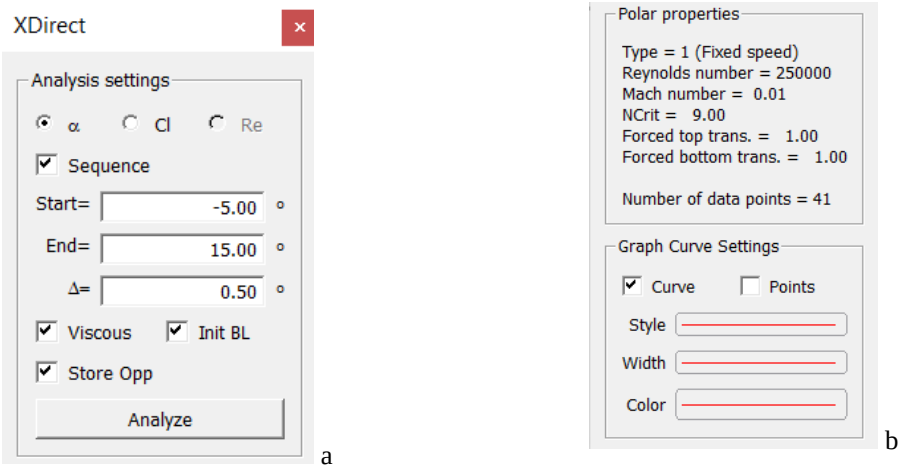
FIG. 4 2D Direct analysis module for airfoil, a. Re numerical evaluation, b. interval Re numerical evaluation

After the setting of these initial conditions for analysis, the user can define the computing interval for the angle of attack, C_l or Reynolds number, resetting the option for the boundary layer (BL), viscous module and the OpPoint function which memorizes the analysis results. For the optimal viewing of the airfoil polars, the user can define a color and thickness for the curves resulted from the numerical simulation as well as displaying the initial conditions for the airfoil, Fig. 5.



a b

FIG. 5 Initial settings of the direct numerical analysis,
a. AoA range, b. display of the initial conditions and visual polar settings

2.2. 3D theoretical analysis

For the geometric configuration of the wing, the user has available a geometric module which can be used to set the chord values; chords coordinates (axis O_x and O_y/offset); dihedral; wing washout; airfoil; type and number of computing panels on O_x and O_y axis; fig. 6.

For a guided user interface (GUI), the geometric module has a display for numerical geometric data for the defined wing; display options on all three axis, isometric; scaling of the wing and the save option for the defined model; fig. 6.

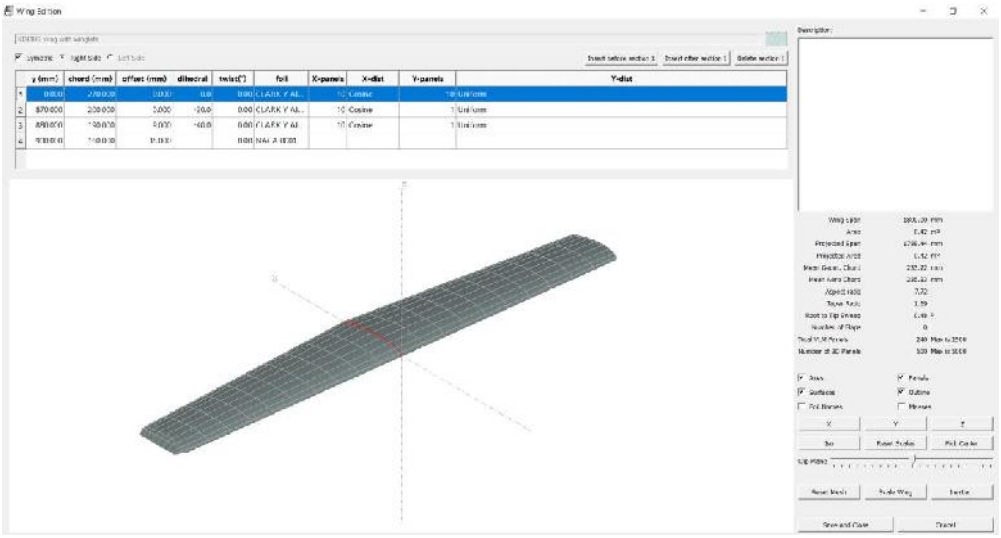


FIG 6 3D geometric module of the singular wing

The 3D analysis of the wing includes a sub-module for the aerodynamic analysis and one for stability analysis. The aerodynamic analysis used in this article is initialized by a series of computing parameters such as: air velocity, polar type, inertial properties, analytical method (LLT, VLM, and 3D panels); viscous/non-viscous module; figure 7.

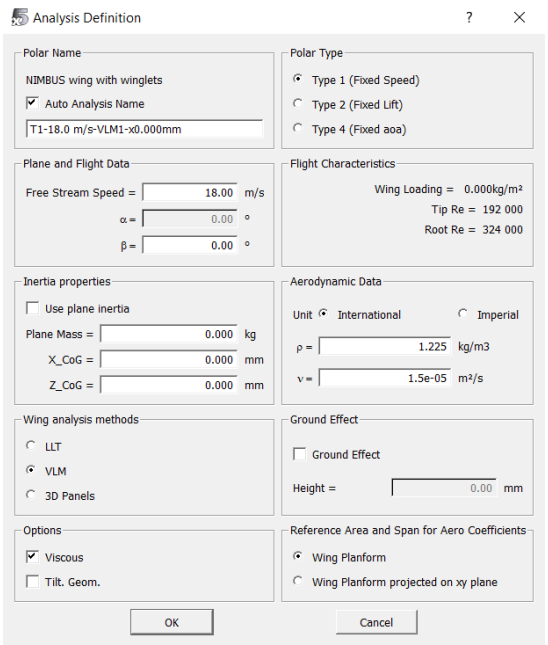


FIG. 7 Numeric analysis module

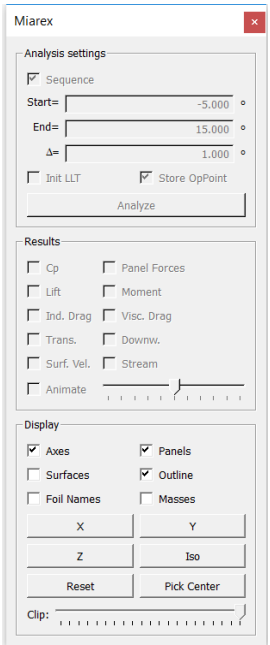


FIG. 8 Analysis functions and view of results

GUI offers displaying functions for the analyzed geometry and for the results: C_l, induced drag, pitching moment (C_m), vortices; figure 8.

3. AERODYNAMIC ANALYZES

For the aerodynamic analyses was used XFLR 5 [3, 4, 5, 12] which offers the instruments needed for the 2D/3D geometry and 3 methods of analyses: VLM, LLT, 3D panel method. For this article we have chosen bi-dimensional aerodynamic analyses for the airfoil and 3D analyses for the wing in 2 specific configurations.

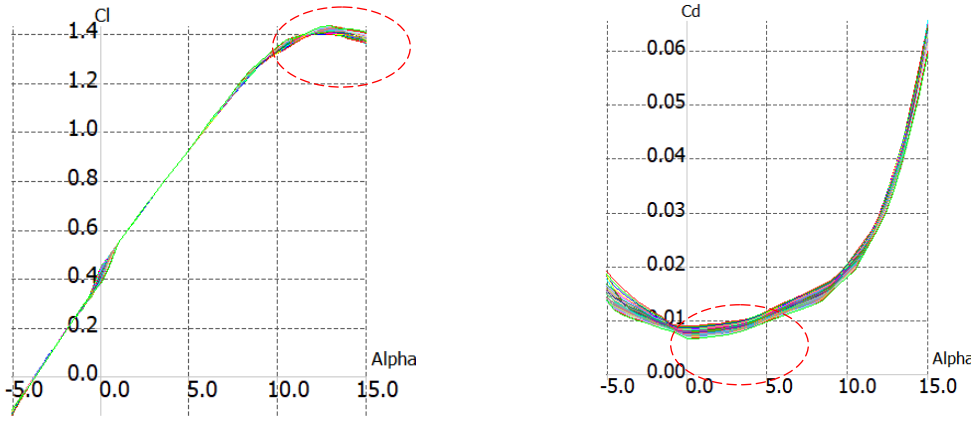
3.1.2D airfoil analysis

The analysis conditions respect the actual speed range (65 ÷ 130 km / h) and the range of AoA for Nimbus MFDs flight, see Table 3.

Table 3. Analysis conditions, [2, 3]

Parameter	Value	Parameter	Value
Re	$2{,}5 \times 10^5 \div 5 \times 10^5$	Air kinematic viscosity	$1{,}42 \times 10^{-5}$
Iterations	1000	AoA	$-5^0 \div 15^0$
Airfoil	Clark Y		

The stages of the 2D airfoil analysis includes: the choosing of the foil geometry (Clark Y) designed in 1922, used for powered and unpowered aircraft, [7, 8, and 9]; the refinement stage of the global foil geometry (maybe redefining the number of characteristic points), the foil analysis stage (defining the Reynolds number interval and the angle of attack interval).



a b

FIG. 2 The polars – aerodynamics coefficient, a. C_l-AoA, b. C_d-AoA

The value of the maximum lift coefficient be seen in figure 2a corresponding to the angle of attack of 12^0, and the drag coefficient increases exponentially after an angle of attack exceeding 10^o (figure 2b).

The pitching moment coefficient (C_m) shows a constant growing instability in the interval AoA=$1^o \div 14^o$ (figure 3a). The analyses airfoil has a maximum C_l to C_d ratio around of AoA=4^o (figure 3b). For a highly reliable aerodynamic analysis with a higher level of accuracy, the usage of mathematical computing software like Matlab, Maple, is required [10, 11].

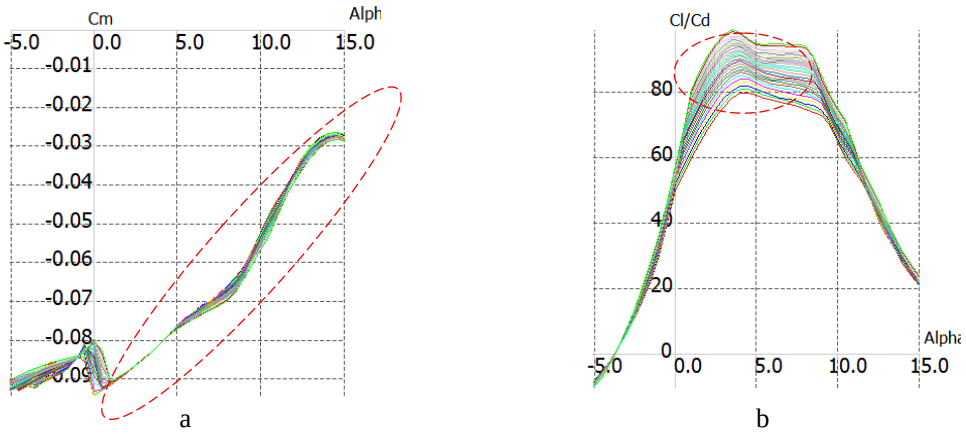


FIG. 3 The polars – aerodynamics coefficient, a. C_m vs. AoA, b. gliding ratio C_l/C_d vs. AoA

3.2. 3D wing analysis

The 3D geometry analysis requires the usage of 1:1 scale for the Nimbus wing; see figure 4 and table 4.

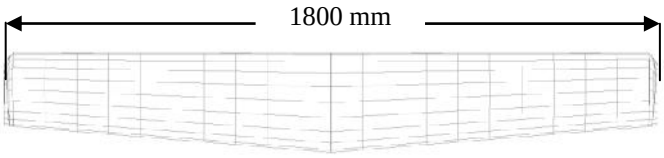


FIG. 4 MFD Nimbus wing

The geometric configuration of the wing analysis presents a mesh made up of 10 panels for wing span and 10 panels for chord.

Table 4. Geometric features, [2, 3]

Parameters	Value	Parameter	Value
Airfoil	Clark Y	Surface	0,42 m^2
Span	1800 mm	Twist	0^0
C_0 / C_e	270 mm / 200 mm	AR	7,72
Taper ratio	1,69	MAC	235 mm

The initial conditions for the analysis highlight the real flight limitations of MFD Nimbus; see table 5.

Table 5. Initial conditions, [2, 3]

Parameter	Value	Parameter	Value
Re	$2,5 \times 10^5 \div 5 \times 10^5$	Air kinematic viscosity	$1,42 \times 10^{-5}$
Iterations	100	AoA	$-5^0 \div 15^0$
Method	LLT / VLM	Tip Re / Root Re	192000 / 324000
Polar	Constant speed	Speed	18 m/s
Boundary conditions	Dirichlet	VLM/ 3D panels	240 / 500
Angle sideslip	0^o		

The 3D aerodynamic analysis of the wing generates the variation of the main aerodynamic characteristics (figure 5 and 6) using 2 analysis methods (LLT and VLM). The computing situation is made at the characteristic minimum speed of 18 m/s.

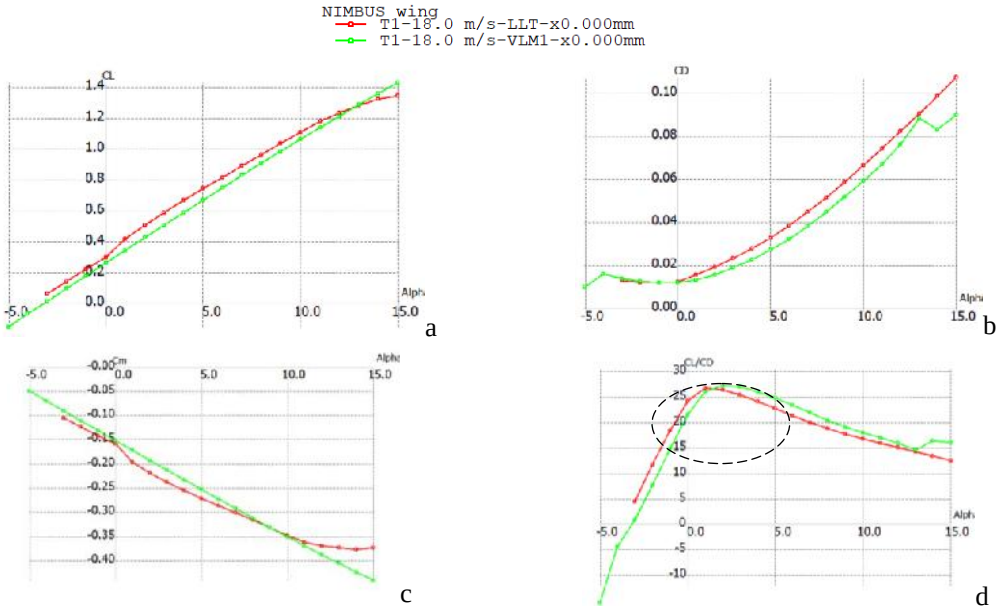


FIG. 5 Aerodynamic features of the singular wing for MFD Nimbus at V=18 m/s, a. C_L vs. AoA, b. C_D vs. AoA, c. C_m vs. AoA, d. gliding ratio C_L/C_D vs. AoA

LLT and VLM methods have produced close results for the C_l on the interval $1^o \div 9^o$ (figure 5a) while the C_d rises exponentially in a similar manner after AoA=5^0 (figure 5b). The slope of the pitching moment coefficient keeps a constant value and the actual value of the C_m has close values for the both types of analysis (figure 5c). The maximum gliding ratio (C_L/C_D vs. AoA) has a maximum value at AoA=$2 \div 3^o$, with small absolute differences (-0,23 vs. -0,27), figure 5d.

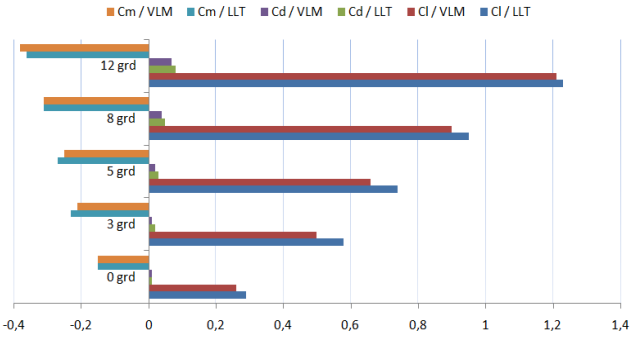


FIG. 6 Comparative charts with date for 18 m/s

Fig.7 highlights the lift distribution on the wing and the drag for each wing segment with the changes in angle of attack. With an increasing air velocity, the analysis shows a corresponding increase in drag at the wing tips.

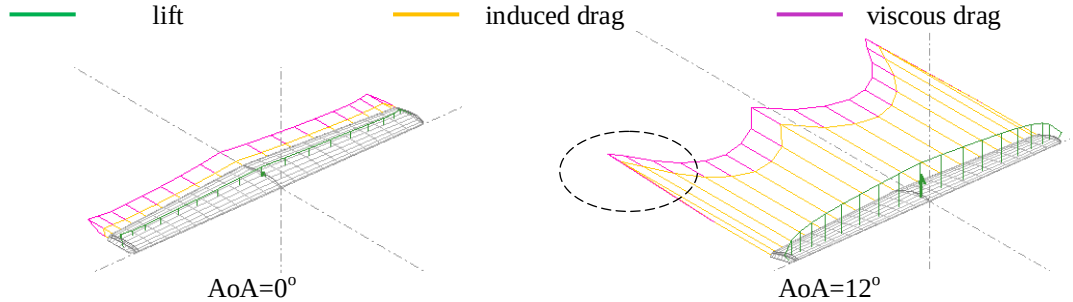


FIG. 7 The variation of lift and drag function of the angle of incidence (AoA) for V=18 m/s

4. CONCLUSIONS

The article drew the guidelines of a preliminary aerodynamic analysis for a classical configuration of an operational UAV (MFD Nimbus). This analysis was center on the 2D airfoil and the 3D wing geometry.

The analysis of an airfoil in viscous conditions using XFOIL offer good, efficient and precise results, but it also has its errors (the compressibility corrections are invalid) when the airfoil has an irregular geometry of its leading edge or has one which is too sharp (invalid geometrical settings).

XFLR5 is a freeware (GPL) instrument which can be successfully used for estimations of the aerodynamic performances of: unpowered, fixed-wing aircraft (estimated values with aerodynamic interferences), lifting singular surfaces (wings, tails), bodies of revolutions (fuselages, fairings) and other aerodynamic bodies (various fairing, floats).

In order to achieve highly reliable results the user needs precise geometric features for the working models and also very well defined analysis settings and restrictions.

ACKNOWLEDGMENT

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COAXIAL ROTOR SYSTEMS – CHARACTERISTICS AND PERFORMANCES

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Abstract: *In this paper are presented some results regarding the main aerodynamic characteristics and power performances of the coaxial helicopters. Based on the fluid dynamics laws which govern the air flow model through the helicopter rotor disc, in this study were made two case studies which point out that the induced power ratio relative to the power required to operate the two isolated rotors and the coaxial rotors are in favor of the later constructive solution .*

Keywords: *rotor blade, helicopters, autorotation, rotor thrust, induced power.*

1. INTRODUCTION

The main way to distinguish between different helicopter main rotor systems is represented by the blade movement degree of freedom, namely flapping, led-lag and feathering. The most common configuration is the single main rotor helicopter which consists of one main rotor, gearbox, tail rotor drivershaft, intermediate gearbox, tail rotor and engine (fig. 1).

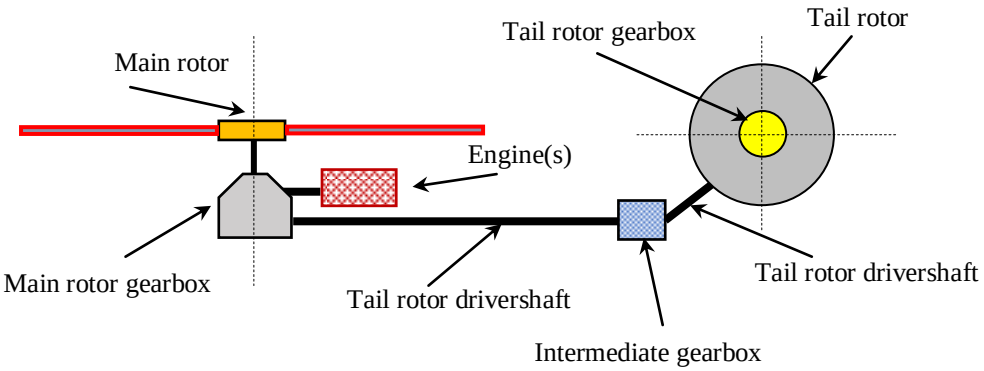


FIG. 1

Another variant is the coaxial rotor helicopter which eliminates the need for a tail rotor by using counter rotating main rotors. One advantage of the counterrotating rotors is that the net size of the rotors is reduced because each rotor provides vertical thrust and all power can provide vertical lift and helicopter control [1]. The tow rotors interact with one another, producing aerodynamic interferences, which leads to loss of system efficiency. Also, this type of helicopter has a very complex mechanical systems, having a great number of moving parts (fig. 2).

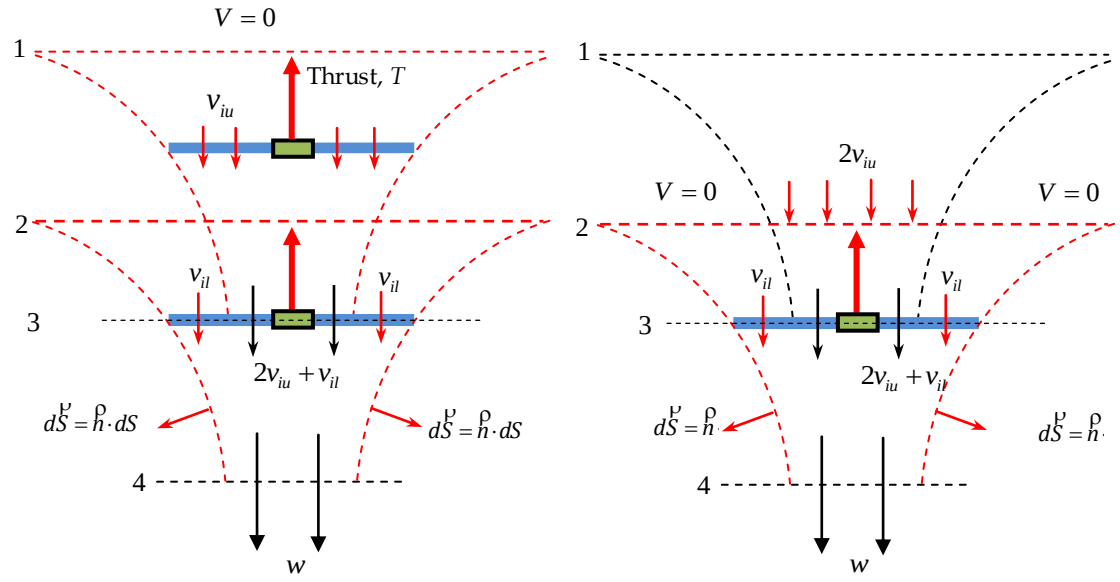
The coaxial rotor systems avoid the effect of lift dissymmetry (lift is proportional to the square of the relative air velocity and it is much greater on the rotor blade advancing side than on the retreating side) [2]. The yaw control is accomplished by increasing the collective pitch of one rotor and decreasing the collective pitch of the other.

Figure 2 shows a coaxial rotors helicopter and the rotors hub with the mechanical links between the swash plates and rotors blades [3].

a) Coaxial rotor b) Rotor mechanisms

FIG. 2

The flow model for a coaxial helicopter where the lower rotor is considered to operate in the fully developed slipstream of the upper rotor is presented in the fig. 3.



a) Rotor control volume b) Lower rotor control volume

FIG. 3

In the figure 3 are represented two rotors with the same disc area. The fluid dynamics lows are applied on the whole flow domain [4].

2. INDUCED POWER EVALUATION

Assuming that the rotor planes are sufficiently close together and that each rotor provides an equal fraction of the total system thrust the effective induced velocity of the hole rotor coaxial system is

$$\left(v_i\right)_{\substack{independent\\rotors}} = \sqrt{\frac{T}{2\rho A}} \tag{1}$$

where A is the disc rotor area, ρ is air density and T is the rotor thrust.

The induced power is

$$\left(P_i\right)_{\substack{independent\\rotors}} = \left(2T\right)\left(v_i\right)_{\substack{independent\\rotors}} = 2T\sqrt{\frac{T}{2\rho A}} = \sqrt{2}\sqrt{\frac{T^3}{\rho A}} \tag{2}$$

For the coaxial rotors, which together generate a thrust force equal to 2T, the induced velocity has the expression

$$\left(v_i\right)_{\substack{coaxial\\rotors}} = \sqrt{\frac{2T}{2\rho A}} \tag{3}$$

The induced power for the coaxial rotors is

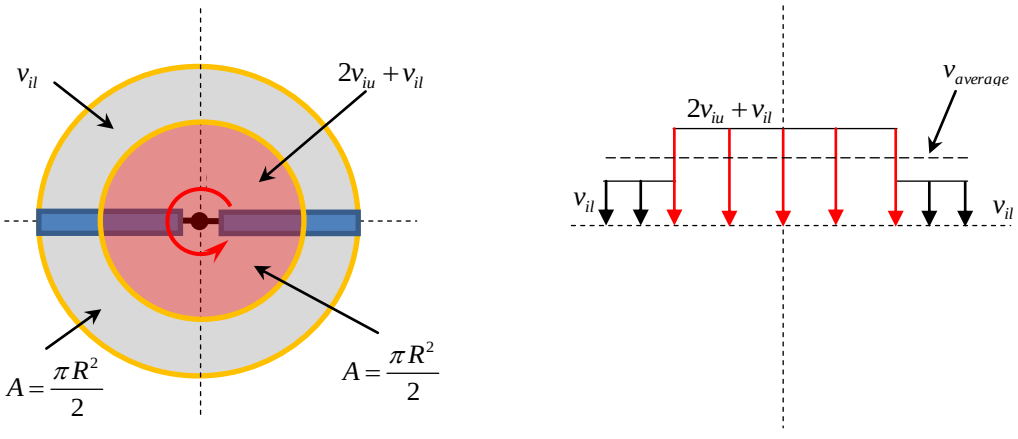
$$\left(P_i\right)_{\substack{coaxial\\rotors}} = \left(2T\right)\left(v_i\right)_{\substack{coaxial\\rotors}} = 2T\sqrt{\frac{\left(2T\right)}{2\rho A}} = 2\sqrt{\frac{T^3}{\rho A}} \tag{4}$$

If the interference induced power factor k_{int} is considered for the power of the coaxial rotors and the independent rotors, then,

$$k_{\text{int}} = \frac{\left(P_i\right)_{\substack{coaxial\\rotors}}}{\left(P_i\right)_{\substack{independent\\rotors}}} = \frac{2}{\sqrt{2}} = \sqrt{2} = 1{,}41 \tag{5}$$

which is a 41% increase in induced power relative to the power required to operate the two isolated rotors.

The evaluation of 41% percentage was obtained on the basis of momentum theory without taking into consideration the space between the two rotors. In fact, one of the rotor is placed upper so that the velocity through the lower rotor is two times greater than the velocity through the upper disc rotor [5]. The control volume for coaxial rotors is presented in the fig. 3. Taking into account that the double velocity in the upper current tube is obtained in a section where the area is half of rotor disc area (the two rotors have the same disc area), this means that on a half of the lower rotor the air velocity is $2v_{iu} + v_{il}$ and on the other half the air velocity is v_{il} (fig. 4), where the subscripts u and l have the significance of "upper" and "lower".



a) b)

FIG. 4

The flow model applied to the lower rotor is presented in the fig. 3b. According to the momentum equation, the rotor thrust is

$$\vec{T}_l = \iint_{S_4} \rho\left(\vec{V}\cdot d\vec{S}\right)\vec{V} - \iint_{S_2} \rho\left(\vec{V}\cdot d\vec{S}\right)\vec{V} = \dot{m}_l\vec{w} - \dot{m}_u\left(2\vec{v}_{iu}\right) \tag{6}$$

Taking into account the mathematical expressions of the mass flow rates, by replacing it in the above equation, one can get

$$T_l = \rho A\left(v_{iu}+v_{il}\right)w - \rho A v_{iu}\left(2v_{iu}\right) = \rho A\left(v_{iu}+v_{il}\right)w - T_u \tag{7}$$

that leads to the equation

$$T_l + T_l = \rho A\left(v_{iu}+v_{il}\right)w \tag{8}$$

On the lateral surface of the control volume, the double integral is zero because the vectors $d\vec{S} = \vec{n}\cdot dS$ and $\vec{V}$ are perpendicular. Also, the unit vector $\vec{n}$ is oriented outward of the current tube, that is in front of the second integral in equation (6) appears the sign minus, because on this surface and, generally on the any inlet section the air velocity and the unit vector have contrary sign, unlike outlet section, where the air velocity and the unit vector have the same sign [6].

The work on unit time, namely the power consumed by the rotor for gaining in cinetic energy is obtained from the equation,

$$\begin{aligned} P_l &= \iint_{\substack{controll\\surface}} \left(\rho\frac{1}{2}V^2\right)\vec{V}\cdot d\vec{S} = \iint_{suface4}\left(\rho\frac{1}{2}V^2\right)\vec{V}\cdot d\vec{S} + \iint_{\substack{lateral\\surface}}\left(\rho\frac{1}{2}V^2\right)\vec{V}\cdot d\vec{S} + \iint_{surface2}\left(\rho\frac{1}{2}V^2\right)\vec{V}\cdot d\vec{S} = \\ &= \frac{1}{2}\dot{m}_l V^2\Big|_{surface4} + 0 - \frac{1}{2}\dot{m}_l V^2\Big|_{surface2} \end{aligned} \tag{9}$$

The air velocity in section 4 is w and in section 2 the velocity is zero in the outside of the upper rotor current tube and $2v_{iu}$ on the inner part of this current tube (fig. 3b), that leads to the following expression for the power P_l,

$$P_l = \frac{1}{2}\underbrace{\left[\rho A\left(v_{iu}+v_{il}\right)\right]}_{\dot{m}_l}w^2 - \frac{1}{2}\underbrace{\left(\rho A v_{iu}\right)}_{\dot{m}_u}\left(2v_{iu}\right)^2 = \frac{1}{2}\rho A\left(v_{iu}+v_{il}\right)w^2 - 2\rho A v_{iu}^3 \tag{10}$$

The power P_l is expressed as a product between the thrust force and the air velocity through the lower rotor disc [7]. The average velocity is obtained as a medium velocity, taking into account that on the inner part of the lower disc the air velocity is $2v_{iu}+v_{il}$ and on the other half part the air velocity is v_{il},

$$v_{average} = \frac{\frac{A}{2}v_{il} + \frac{A}{2}\left(2v_{iu}+v_{il}\right)}{\frac{A}{2}+\frac{A}{2}} = v_{iu}+v_{il} \tag{11}$$

Therefore, the lower rotor power consumed has the expression

$$P_l = T_l\left(v_{iu}+v_{il}\right) \tag{12}$$

that leads to the following expression for the energy equation, applied to the lower rotor

$$T_l\left(v_{iu}+v_{il}\right) = \frac{1}{2}\rho A\left(v_{iu}+v_{il}\right)w^2 - 2\rho A v_{iu}^3 \tag{13}$$

or, taking into account the equation (8), it follows that

$$T_l\left(v_{iu}+v_{il}\right) = \frac{1}{2}\left(T_l+T_u\right)w - T_u v_{iu} \tag{14}$$

3. CASE STUDIES

Case 1. The two rotors develop the same thrust force, *T*

In this situation, the equation (14) becomes,

$$T(v_{iu}+v_{il})=\frac{1}{2}(2T)w-Tv_{iu} \tag{15}$$

and this leads to the following expression for the wake velocity *w*

$$w=2v_{iu}+v_{il} \tag{16}$$

By replacing velocity w and thrust force $T=2\rho Av_{iu}^2$ in equation (8), one can get $2\left(2\rho Av_{iu}^2\right)=\rho A(v_{iu}+v_{il})(2v_{iu}+v_{il})$

(17)

By rearranging the terms and simplifying with ρA, the above equation is transformed in

$$v_{il}^2+3v_{iu}v_{il}-2v_{iu}^2=0 \tag{18}$$

This equation has the following positive solution

$$v_{il}=\left(\frac{-3+\sqrt{17}}{2}\right)v_{iu}=0{,}5616v_{iu} \tag{19}$$

For both rotors the total power is $P_{tot}=P_u+P_l=Tv_{iu}+T(v_{iu}+v_{iu})=T(2v_{iu}+v_{il})=2.5616\,Tv_{iu}$, this means that the induced power factor from interference, k_{int}, is given by

$$k_{\text{int}}=\frac{(P_i)_{coaxial\ rotors}}{(P_i)_{independent\ rotors}}=\frac{2.5616\,Tv_{iu}}{2Tv_{iu}}=1.281 \tag{20}$$

which is a 28% increase compared to a 41% when the two rotors have no vertical separation.

Case 2. The two rotors develop the same induced power, P.

The mathematical expressions of induced powers for the two rotors are the following:

- The upper rotor, $P_u=2\rho Av_{iu}^3$
- The lower rotor, $P_l=\frac{1}{2}\rho A(v_{iu}+v_{il})w^2-P_u$

From condition that the two induced power are equal, $P_u=P_l=P=2\rho Av_{iu}^3$, it follows that

$$2\left(2\rho Av_{iu}^3\right)=\frac{1}{2}\rho A(v_{iu}+v_{il})w^2 \tag{21}$$

or

$$w=\sqrt{\frac{8v_{iu}^3}{v_{iu}+v_{il}}} \tag{22}$$

On the other hand, from the expression of the lower rotor power, $P_l=T_l(v_{iu}+v_{il})$ and mathematical expression of upper rotor power, $P_u=T_uv_{iu}$, it follows also

$$T_l=\frac{P_l}{v_{iu}+v_{il}}\ \text{and}\ T_u=\frac{P_u}{v_{iu}} \tag{23}$$

According to the equation (8), the sum of thrusts is

$$T_u+T_l=\rho A(v_{iu}+v_{il})w \tag{24}$$

so that

$$\frac{P_u}{v_{iu}}+\frac{P_l}{v_{iu}+v_{il}}=\rho A(v_{iu}+v_{il})w \tag{25}$$

By replacing the powers with expression $2\rho A v_{iu}^3$ and the velocity *w* from equation (22) one can obtain

$$2\rho A v_{iu}^3\left(\frac{1}{v_{iu}}+\frac{1}{v_{iu}+v_{il}}\right)=\rho A\left(v_{iu}+v_{il}\right)\sqrt{\frac{2v_{iu}}{v_{iu}+v_{il}}} \tag{26}$$

With some few transforms and putting the new variable $t=v_{iu}/v_{il}$, the above equation becomes,

$$t\left(1+\frac{1}{1+\frac{1}{t}}\right)=\left(t+1\right)\sqrt{\frac{2t}{t+1}} \tag{27}$$

The solution of equation (27) can easily be found in Maplesoft environment (the solution is $t=2{,}2853$). This means that

$$v_{il}=\frac{1}{2.2853}v_{iu}=0.4375v_{iu} \tag{28}$$

When the coaxial rotors operate at equal rotor torques, the induced power factor k_{int} is given by

$$k_{\text{int}}=\frac{2.4375v_{iu}}{2v_{iu}}=1.219$$

with a 22% increase, compared to the case when the two rotors are operated isolated. Figure 5b shows the power ratio P/P_{hover} for a classical constructive solution (one main rotor and tail rotor configuration).

CONCLUSIONS

The results presented in this paper show that, under some approximation and assumptions, the application of the fluid dynamics laws permits the analysis of the factors that influence the coaxial rotors. The model analyzed in this study allows a preliminary evaluation of the helicopters performances in hover, climb and descent flight.

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EXPERIMENTAL DETERMINATION OF THE VERTICAL SPEED OF A PRACTICAL AVIATION BOMB, FORCEFULLY SEPARATED FROM THE AVIATION ARMAMENT MOUNT

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Abstract: *The article depicts the determination of the the initial vertical velocity of an aviation bomb using a high-speed camera and a stand.*

Keywords: *air bomb, beam support, mathematical expectation, standard deviation, forced separation, aviation armament installation.*

1. INTRODUCTION

The issue of aviation bomb detachment has not yet been resolved in full. This problem concerns the safety of the separation and the accuracy of the bombing. The safety of the separation is achieved by the formation of such initial flight conditions of aviation bombs, which exclude the possibility of collisions of the bombs with the elements of the airplane structure, the beam supports and the loads hung on them. The forced detachment of aviation bombs provides separation safety and reduces technical dissipation.

At present, there is no quantitative information on the vertical initial velocity of forcibly ejected aviation bombs. To calculate the technical dissipation, it is necessary to determine this speed.

2. DETERMINATION OF THE VERTICAL INITIAL VELOCITY OF A PRACTICAL AVIATION BOMB P-50-75, SUSPENDED ON SUPPORT MBD2-67U

Based on the methodology [1], an experiment was conducted (aground) to determine the initial vertical velocity of a practical aviation bomb.

The experiment was carried out on a MiG-21 aircraft, a beam support BD3-60-21, a multi-beam girder holder MBD2-67U, a PPP (10 pcs.), A stand and a high-speed camera.

When the first and second laser beams intersect, the signals are fed to a microcontroller with a working frequency of 16 MHz. The controller measures the motion time of the bomb between the two laser beams. From the known formula:

$$h_3 - h_2 = V_{уп} t_{изм} + \frac{g t_{изм}^2}{2}, \quad (1)$$

the forced vertical velocity $V_{уп}$ is determined:

$$V_{уп} = \frac{\left(h_3 - h_2 - \frac{g t_{изм}^2}{2} \right)}{t_{изм}}. \quad (2)$$

The plan for placing of the practical bomb and the laser sensors is shown in Fig. 1.

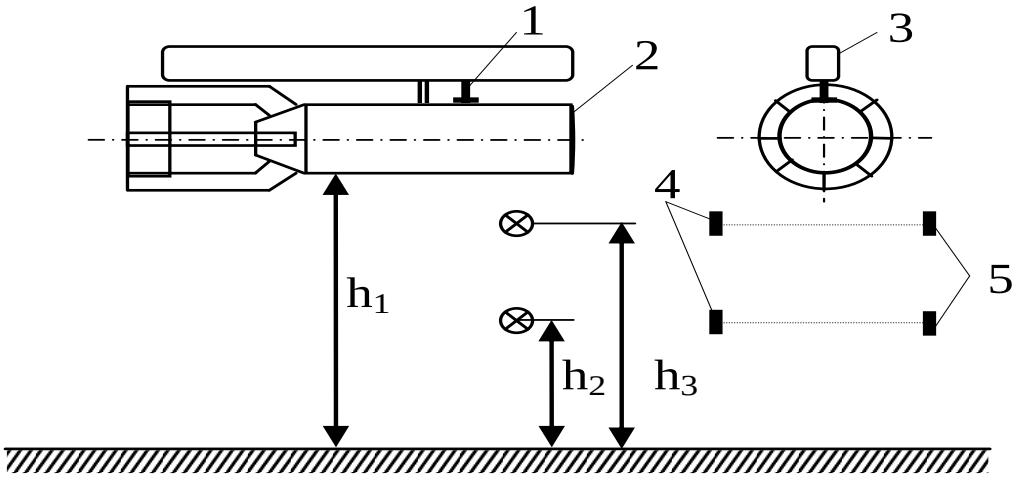

FIG. 1 Scheme of the experiment
1 - piston; 2 - practical bomb; 3 - beam supports; 4 - laser; 5 - laser sensor;
h1 = 910 mm - distance from the practical bomb to the ground;
h2 = 500 mm - distance from the second laser to the ground;
h3 = 810 mm - Distance from the first laser to the ground.

Table 1 shows the values of the forced vertical speed $V_{уп}$ and the time $t_{изм}$ for 10 attempts.

Table 1

n	1	2	3	4	5
$V_{уп}$ [m/s]	0,97	1,05	1,13	1,08	1,15
$t_{изм}$ [s]	0,1713	0,1662	0,1613	0,1644	0,1602

n	6	7	8	9	10
$V_{уп}$ [m/s]	0,97	1,13	0,95	0,97	1,05
$t_{изм}$ [s]	0,1713	0,1613	0,1726	0,1713	0,1662

Mathematical expectation and average quadratic deviation of forced vertical velocities $V_{уп}$:

$$M[V_{уп}] = \frac{\sum_{j=1}^{n} V_{уп_j}}{n} = 1{,}0450 \ \text{m/s};$$
$$\sigma_{V_{уп}} = \sqrt{\frac{\sum_{j=1}^{n} \left(V_{уп_j} - M[V_{уп}] \right)^2}{n-1}} = 0{,}0765 \ \text{m/s}. \quad (3)$$

The confidense interval I_β of the mathematical expectation $M[V_{уп}]$ determined with a confidence probability β=0,95, is calculated by [4]:

$$I_\beta = \left(\tilde{m} - t_\beta \sqrt{\frac{D_{V_{уп}}}{n}};\quad \tilde{m} + t_\beta \sqrt{\frac{D_{V_{уп}}}{n}}; \right), \tag{4}$$

where t_β=1,96.

The half length of the confidence interval ε_β is determined by:

$$\varepsilon_\beta = t_\beta \sqrt{\frac{D_{V_{уп}}}{n}} = 0{,}0474. \tag{5}$$

From Form. (3 and 4) - the confidence interval I_β of mathematical expectation $M[V_{уп}]$: I_β=(0,9976; 1,0924).

The confidence interval, $I_{D\beta}$ dispersion $D_{V_{уп}}$, vertical speed $V_{уп}$, determined with confidence probability β=0,95, are calculated using formulas [4]:

$$I_{D\beta} = \left(D_{V_{уп}} - t_\beta \sqrt{\frac{2}{n-1}} D_{V_{уп}};\quad D_{V_{уп}} + t_\beta \sqrt{\frac{2}{n-1}} D_{V_{уп}} \right); \tag{6}$$

$$I_{D\beta} = \left(4{,}4488.10^{-4};\quad 0{,}0113\right),$$

or the confidence interval $I_{\sigma\beta}$ of the square quadratic deviation $V_{уп}$:

$$I_{\sigma\beta} = \left(0{,}0211;\ \ 0{,}1061\right).$$

It is clear that the mathematical expectation $M[V_{уп}]$ and the average square deviation $\sigma_{V_{пу}}$ of $V_{уп}$ are within the confidence limits of I_β and $I_{\sigma\beta}$.

The vertical speed $V_{уп}$ was also determined by a high-speed camera at 25,000 frames per minute.

The reading starts from the firing of the pyrocartridge PPL and ends with the fall of the bomb on the ground.

From the formula:

$$V_{уп} = \frac{\left(h_1 - \frac{g t_{изм}^2}{2} \right)}{t_{изм}},$$

the following results are obtained:

Table 2

n	**1**	**2**	**3**	**4**	**5**
$V_{уп}$ [m/s]	1,4282	1,4595	1,4604	1,5051	1,3995
$t_{изм}$ [s]	0,3091	0,3069	0,3069	0,3038	0,3111
n	**6**	**7**	**8**	**9**	**10**
$V_{уп}$ [m/s]	1,4661	1,5002	1,3805	1,4715	1,4928
$t_{изм}$ [s]	0,3065	0,3041	0,3124	0,3061	0,3046

The mathematical expectation and the average quadratic deviation of the forced vertical velocities $V_{уп}$:

$$M[V_{уп}] = 1{,}3544 \text{ m/s}; \quad \sigma_{V_{уп}} = 0{,}0418 \text{ m/s}.$$

The calculated values of the forced vertical velocity $V_{уп}$ in both methods show the convergence of the results. Differences in mathematical expectations

$$\Delta M[V_{уп}] = M[V_{уп}]_{и} - M[V_{уп}]_{к} = 1{,}045 - 1{,}3544 = -0{,}3094 \text{m/s}$$

and the average square deviations

$$\Delta\sigma_{V_{уп}} = \sigma_{V_{уп_{и}}} - \sigma_{V_{уп_{к}}} = 0{,}07 - 0{,}04 = 0{,}03 \text{ m/s}$$

of $V_{уп}$ are determined by the inaccurate determination by the high-speed camera of the moments of the beginning of the separation and the fall of the practical bomb P-50-75.

3. CONCLUSIONS

The initial forced vertical velocity of a practical aviation bomb is determined. Based on this speed, it is possible to calculate the technical scattering of aviation bombs and to determine the influence of the forced separation on the technical dissipation.

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AXISYMMETRIC FRONTAL SUPERSONIC INLET FOR TRISONIC AIRCRAFT

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Abstract: *The paper deals with an air inlet meant to equip a trisonic aircraft. Starting from the shock-wave system geometry (two external waves and two internal waves), one has applied an algorithm based on inlet's efficiency maximization, for the most employed flight regime, in order to determine its optimal architecture (optimal angles for the centerbody and the cowl's lip), as well as its characteristic maps. In order to assure a better adapting to aircraft flight regime, one has determined inlets centerbody positioning with respect to the flight Mach number, which may be used as inlet's control law. The study is useful for further inlet's automation possibilities analysis, as well as for similar inlets architecture establishing.*

Keywords: *supersonic, inlet, shock-wave, centerbody, cowl, Mach number, geometry.*

1. INTRODUCTION

One of the most important nowadays challenge for aerospace engineers and manufacturers is the flight at very high speeds, both for military and for civil purposes, for atmospheric and for suborbital and orbital missions.

The interest shown by the military in hypersonic flight is obvious, high speed weapons (or platform for weapons) offering strategic and tactical advantages. Nevertheless, the supersonic and even the hypersonic passenger transport has been reconsidered in the last decade and is still a hot subject up for debates.

Regardless the mission of a high-speed vehicle, a lot of challenges need to be overcome before it could be put into service and fulfill its tasks. The aerodynamic viscous friction effect and the occurred shock waves give so high body temperatures that no conventional materials can withstand them, so new heat-resistant and resilient materials are to be designed and new suitable manufacturing concepts and techniques are to be implemented; aircraft new body structures and new aircraft propulsion systems means new flight techniques, which, obviously, need new sensors, new equipment and suitable commands and control laws and architectures.

High speed aircraft must have suitable propulsion systems (usually air-breathing engines, but also rocket engines), such as high thrust jet engines without or with afterburning, ramjets or scramjets, or even detonation engines (pulse detonation engines, rotating detonation engines or continuous detonation engines). No matter the air-breathing engine, it should have an inlet with suitable geometry, assisted by a control system, in order to assure the necessary air mass flow rate, velocity and pressure and to keep the engine in a stable operating mode ([2, 5]).

Inlets are built up in a variety of shapes and sizes, usually imposed by the speed of the aircraft. The inlet has a very important connection and correlation role; it should transform the air parameters outside the engine into suitable parameters inside the engine, especially when it's about the speed and the pressure.

Improper air velocity in front of the compressor may trigger shock-waves and makes impossible the air compression, while improper pressure condition can lead to a significant thrust decrease, without mentioning the thermal overload. Consequently, the inlet should adapt to the flight regime (reflected by the flight Mach number) in order to keep the pressure and temperature parameters within the permissible range ([2, 5, 6]).

In this paper one has studied an axisymmetric supersonic frontal inlet with mixed compression, meant to equip a trisonic aircraft; the considered flight speed (the freestream air velocity) is at least three times the sound speed $(M_H = 3.0)$.

2. INLET PRESENTATION

The inlet (see Fig. 1) consists of an axisymmetrical air intake with sharp cowl lip and a conical centerbody (nose). The centerbody triggers two conical shock-waves (which are the source of the external compression), while the intake's cowl lip triggers another conical shock-wave. The last shock-wave is a normal-one and is triggered inside the inlet's duct; the normal shock-wave, together with the lip's conical shock-wave are the source of the internal compression. Consequently, the described inlet is a mixed-compression-one.

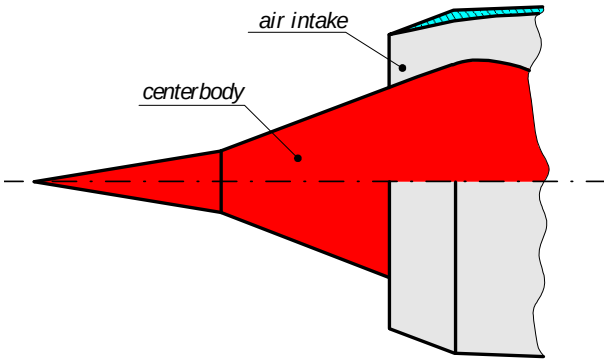


FIG. 1. Supersonic axisymmetric air inlet

The centerbody has two sections, each one having its own flaring angle (θ_1 and θ_2, see Fig. 2); sections' lengths and flaring angles are determined in order to assure the focal point F attachment to the cowl's lip (D-point). Intake's cowl lip has its own angle θ_3 and triggers another conical shock-wave (DC in Fig. 2), which develops inside the intake; together with this conical wave, it appears the final normal shock-wave (CC$'$ in Fig. 2), so the air stream in front of the engine becomes subsonic.

Inlet's characteristics are: a) the efficiency characteristic (which means inlet's total pressure recovery σ_i^* versus freestream Mach number) and b) the flow characteristic (inlet's flow ratio coefficient C_D versus freestream Mach number).

This kind of axisymmetric inlet might be used as frontal inlet (in the front of aircraft's fuselage) for single engine aircrafts or in the front of the nacelle for multi-engine aircrafts (when the nacelles are mounted on the wings or on the fuselage).

The adapting of the inlet to different flight regimes may be realized only by the centerbody's longitudinal displacement (in order to keep the focal point of the external compression outside the intake and avoid the shock-wave reflection inside it).

3. INLET OPTIMAL ARCHITECTURE

Air inlet design is an important engineering issue, involving geometric, aerodynamic and energetic grounds. Inlet's architecture (geometry) design is based on various methods. The aerodynamic methods are based on analytical and numerical procedures, while the geometric methods are based on planar geometry elements. Optimization criteria are, in most of studied cases, the total pressure recovery maximization (Oswatitsch condition), the drag minimization and/or the inlet flow rate correlation; studies are using various methods, such as "carpet search method" (described in [6] and [8]), or the "method-of-characteristics" (presented in [2]).

In fact, the optimal configuration determination consists of centerbody's angles calculus, as well as dimensionless geometry issuing, based on the determined centerbody's angles. Similar algorithms, but for 2D (planar) inlets, were presented and applied in [7, 9, 12, 13], while algorithms for 3D inlets' optimal configurations were described in [3, 9].

3.1. Optimization criteria. As optimization criterion one has chosen the total pressure recovery σ_i^* maximization. Inlet's total pressure recovery (also known as inlet's perfection coefficient, or inlet's total pressure loss coeficient) σ_i^* is given by

$$\sigma_i^* = \sigma_{csw1}^* \sigma_{csw2}^* \sigma_{csw3}^* \sigma_{nsw}^* \sigma_d^*, \tag{1}$$

where σ_{csw1}^*, σ_{csw2}^* are total pressure ratios for the oblique shock-waves triggered by the centerbody, σ_{csw3}^* – total pressure ratio for the oblique shock-waves triggered by the cowl lip, σ_{nsw}^* – total pressure ratio for the normal shock-wave and σ_d^* – total pressure ratio into intake's duct (assumed as constant, no matter the flight regime or the engine regime would be).

3.2. Conical shock-wave parameters. Air compression through a conical shock-wave is a little different than through an oblique shock-wave [2, 5, 6, 8]; however, there are a lot of geometric and aerodynamic similarities. Conical shock-wave geometry (see Fig. 3) and behavior are described by Taylor-Maccol equations [2, 5, 6].

The first and the most important issue is the calculation of shock-wave's angle β, with respect to the freestream Mach number M_1 (in front of the wave) and the cone angle θ_c. It might be calculated using an implicit non-linear equation (presented in [2] and in [5]):

$$\sin^2\beta = \frac{1}{M_1^2}\frac{1.2}{\cos\beta}\left(\frac{1}{\cos\beta} - \frac{1}{\cos\theta_c} + \ln\frac{\operatorname{tg}\frac{\beta}{2}}{\operatorname{tg}\frac{\theta_c}{2}}\right)^{-1}, \tag{2}$$

while the other parameters may be calculated very similar to the oblique shock-wave. Thus, the

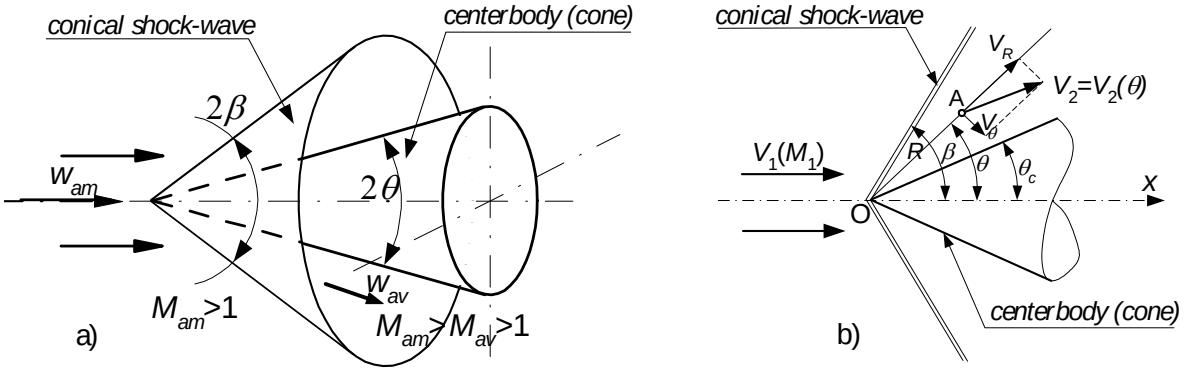


FIG. 3. Conical shock wave's geometry

normal Mach number in the front of the wave M_{1n} is

$$M_{1n} = M_1 \sin\beta, \tag{3}$$

while the normal Mach number behind the wave M_{2n} is similar to the oblique shock-wave:

$$M_{2n} = \sqrt{\left(0.4M_{1n}^2 + 2\right)\cdot\left(2.8M_{1n}^2 - 0.4\right)^{-1}}; \tag{4}$$

the tangent Mach number value remains the same before and behind the shock-wave, $M_{2t} = M_{1t}$:

$$M_{2t} = M_{1t} = M_1 \cos\beta, \tag{5}$$

so the Mach number behind the wave becomes

$$M_2 = \sqrt{M_{2n}^2 + M_{2t}^2}; \tag{6}$$

this Mach number will be the front Mach number for the next shock-wave.

Total pressure recovery coefficient becomes

$$\sigma_{csw}^* = \left[\frac{2.4M_{1n}^2}{2 + 0.4M_{1n}^2}\right]^{3.5}\left[\frac{2.4}{2.8M_{1n}^2 - 0.4}\right]^{2.5}, \tag{7}$$

which, obviously, depends on the values β and θ_c as long as $M_{1n} = M_1(\beta, \theta_c)$.

3.3. **Determining of inlet's optimal geometry.** As stated in [5, 8], inlet's design is performed considering as "nominal" the most intense and most used flight regime. As long as the inlet is a frontal-one and the aircraft it equips can reach a cruise flight speed more than three times the speed of sound, which corresponds to a Mach number bigger than 3, this one will be considered as the nominal Mach number; so, for the geometrical optimization, one has to use the freestream Mach number $M_H = 3.3$ as the M_1 Mach number in front of the inlet.

The optimal inlet configuration is given by the situation when all of the conical shock-waves are convergent into the cowl lip, as Fig. 4 shows; that means that the focal point (point F in Fig. 2) overlaps the cowl lip (point D in Fig. 2).

As far as centerbody's flares angles were chosen as equal $(\theta_1 = \theta_2 = \theta)$, while cowl's lip angle was chosen as half value $(\theta_3 = 0.5\times\theta)$, the algorithm of optimization must determine the value of θ which assures the maximum value of total pressure recovery coefficient σ_i^*.

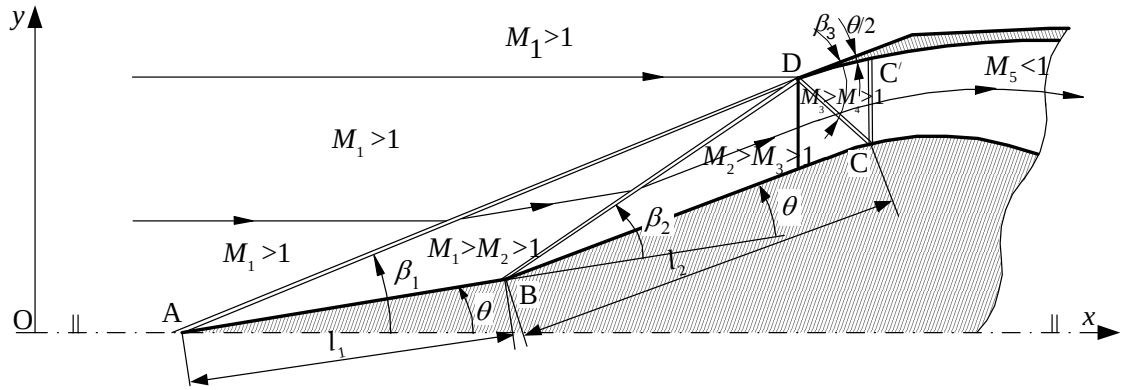


FIG. 4. Inlet with optimal geometry operating at the nominal flight regime

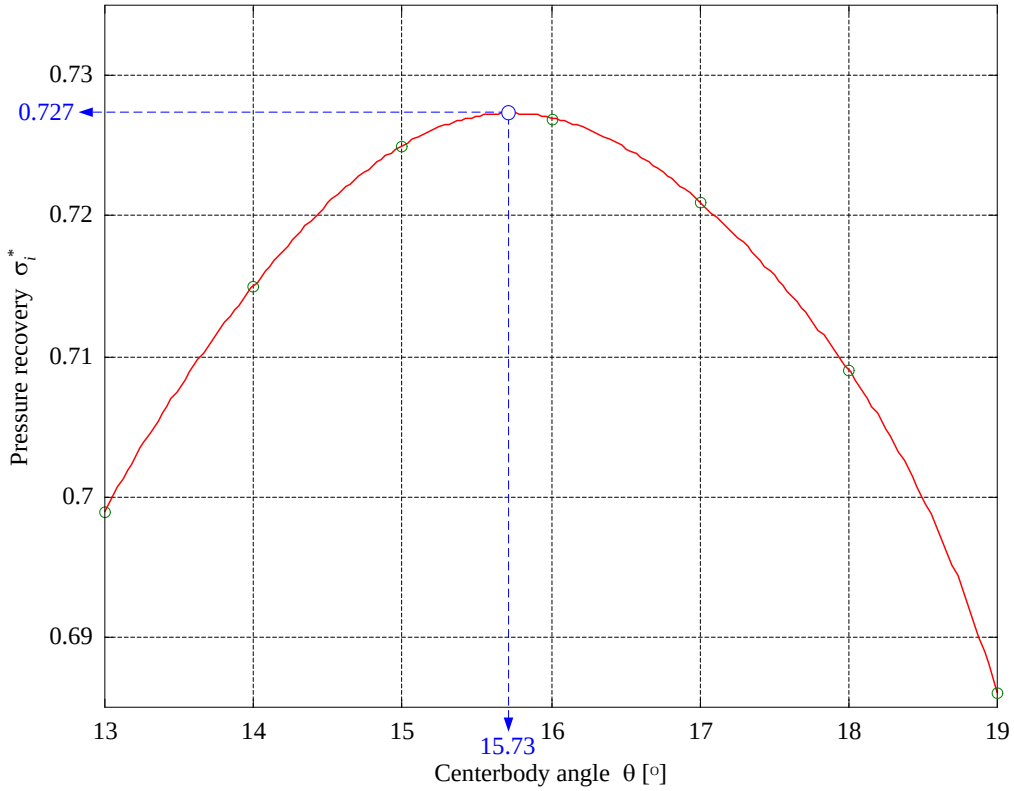


FIG. 5. Total pressure recovery coefficient versus the centerbody angle

Therefore, one has to choose a number of n values for θ and for each configuration (given by a value $\theta_k\left(k=\overline{1,n}\right)$ of the current angle) one has to use the equations (2) to (7) for each one of the conical shock-waves (two external and one internal), in order to determine their total pressure recovery coefficients and the Mach number behind these waves; the last shock-wave is the normal-one, but Eq. (7) may be used for total pressure recovery coefficient calculation; finally, using Eq. (1), the overall inlet total pressure recovery coefficient will be determined.

Applying the algorithm for each $\theta_k\left(k=\overline{1,n}\right)$, one obtains the pressure recovery coefficients $\left(\sigma_i^*\right)_k, k=\overline{1,n}$; the dependence σ_i^* versus θ is graphically represented in Fig. 5. The curve $\sigma_i^*(\theta)$ is a parabolic-one with a maximum point, which corresponds to the maximum possible pressure recovery value $\left(\sigma_i^*\right)_{\max}=0.727$; it is given by the optimal $\theta-$value of the centerbody's flares and of the cowl lip, which is $\theta_{\text{opt}}=15.73^{\text{o}}$.

As stated in [5, 8], the value of the flare angle should be chosen smaller than θ_{opt} with $0.5^{\text{o}}\div 2.0^{\text{o}}$, in order to avoid that the conical shock-waves (triggered by the centerbody) disengage too soon at low supersonic flight speeds. Consequently, one has to choose as centerbody's flare angles the value $\theta_1=\theta_2=15^{\text{o}}$.

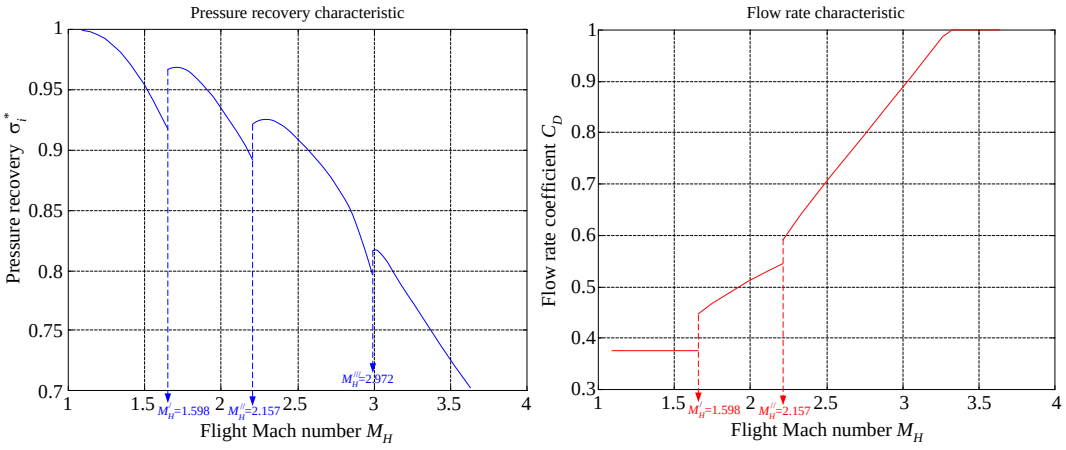
Based on these flare angle values, by solving a simple analytical geometry problem, one can obtain the dimensionless inlet geometry (as shown in Fig. 4), considering the D-point coordinate as equal to the unit $\left(y_{\text{D}}=1\right)$ and the nominal mach number $M_H=3.3$; consequently, after determining β_1,β_2 and β_3 angles (by solving Eq. (2) for each conical external and internal shock-wave), the coordinates of the important nodal points in Fig. 4 become, as follows: A (0;0); B (1.186; 0.329); C (1.983; 0.831); C′ (1.983; 1.103); D (1.678; 1), while the lengths of the segments AB and BC are $l_1=1.231$, $l_2=0.942$.

4. INLET BEHAVIOR VERSUS FLIGHT REGIME

The optimal inlet architecture was designed for a nominal Mach number $M_H = 3.3$, but during the flight, different flight Mach numbers may occur. For different $M_1^{/}$ flight Mach numbers, $M_1^{/} < M_{1_{nom}} = 3.3$, external and internal conical shock-waves are depleting, (as in Fig. 2, comparing to Fig. 4), so angles β_1, β_2 and β_3 are growing, which means that σ_i^* modifies too; withal, the cross section area A_H of the air-breath stream also diminishes.

4.1. Inlet's pressure recovery characteristic chart. As long as the flight Mach number modifies, the shock-waves' geometry and parameters are modifying too, as follows: $\beta_1^{/} = \beta_1^{/}\left(M_1^{/}, \theta\right)$, $M_2^{/} = M_2^{/}\left(M_1^{/}, \theta\right)$, $\beta_2^{/} = \beta_2^{/}\left(M_2^{/}, \theta\right)$, $M_3^{/} = M_3^{/}\left(M_2^{/}, \theta\right)$, $\beta_3^{/} = \beta_3^{/}\left(M_3^{/}, \theta/2\right)$, $M_4^{/} = M_4^{/}\left(M_3^{/}, \theta/2\right)$, $M_5^{/} = M_5^{/}\left(M_4^{/}\right)$, as Eqs. (2) to (6) shows; consequently, each one of the pressure recovery coefficients' values (given by Eq. (7)) changes $\sigma_{csw_k}^* = \sigma_{csw_k}^*\left(M_k^{/}, \beta_k\right), k = \overline{1,3}$, $\sigma_{nsw}^* = \sigma_{nsw}^*\left(M_4^{/}\right)$ with respect to the flight regime Mach number value and, finally, one obtains a dependence $\sigma_i^* = \sigma_i^*\left(M_1^{/}\right)$, which is the pressure recovery characteristic (also known as *pressure characteristic* or as *flight characteristic*).

The above-mentioned characteristic chart is graphically presented in Fig. 6.a); it is noteworthy that the pressure recovery characteristic is not a continuous curve, but it has three discontinuity points, corresponding to some occurred phenomena, such as shock-wave detaching. Thus, considering a decreasing flight Mach number, the first discontinuity point corresponds to $M_H^{///} = 2.972$ when the internal normal shock-wave disappears and the internal conical shock-wave becomes a normal shock-wave in front of the cowl lip; the second discontinuity point corresponds to $M_H^{//} = 2.157$, when the third shock-wave has disappeared and the second external conical shock-wave detaches and becomes a normal shock-wave; the third discontinuity point corresponds to $M_H^{/} = 1.598$, when the first external conical shock-wave detaches and becomes a normal shock-wave just in front of the centerbody and the whole inlet operates like a subsonic-one, because the whole freestream in front of the inlet has subsonic velocity.



a) Inlet pressure recovery characteristic map b) Inlet flow rate characteristic map

FIG. 6. Inlet's characteristic maps (fixed geometry architecture)

4.2. Inlet flow rate characteristic chart. Flow rate coefficient, noted as C_D, is defined as the ratio of the current flow rate and the nominal flow rate [5]; this definition is equivalent to the one which uses the air-breathing circular cross-section areas ratio $A_H / A_{1'}$, which are given by the co-ordinates y_G and y_D in Fig. 2:

$$C_D = \frac{A_H}{A_{1'}} = \frac{A_H}{(A_H)_{nom}} = \frac{\pi y_G^2}{\pi y_D^2} = \frac{y_G^2}{y_D^2} = y_G^2 . \tag{8}$$

Obviously, y_G coordinate depends on the flight Mach number $M_1^{'}$, while y_D coordinate is constant, which means that the flow rate coefficient depends on the flight Mach number $C_D = C_D(M_1^{'})$. Flow rate characteristic chart is graphically presented in Fig. 6.b).

Unlike the pressure characteristic, the flow rate characteristic curve has only two points of discontinuity, corresponding to the Mach numbers $M_H^{''} = 2.157$ and $M_H^{'} = 1.598$, very similar to the flow rate characteristic for the planar inlets with external compression (as presented in [1, 12]). In fact, the flow rate is influenced only by the external conical shock-waves positions, which are responsible of the air-breathing tube cross-section diminishing when the inlet's frontal Mach number (the flight Mach number) diminishes.

5. INLET CONTROL LAW

Operation of an inlet with fixed geometry architecture means a lot of losses from air flow rate's point of view, as Fig. 6.b shows; especially for low or medium Mach numbers, the flow coefficient C_D is far from the maximum value and it could lead to buzz behavior of the inlet, especially when the engine's regime decreases.

In order to grow the C_D-value, a suitable solution is to keep the second conical shock-wave attached to the cowl's lip, progressively displacing longitudinally the centerbody, which means that the inlet should be tuned with respect to the flight regime. As Fig. 2 shows, when the flight regime is less intense than the nominal-one, the conical shock-wave are depleting and moving away from the cowl's lip, so the focal point F departs from D. Consequently, in order to bring back at least the second wave on the cowl's lip, the distance DD$^{'}$ should be cancelled; it could be achieved only by retracting the centerbody. On the contrary, if the flight regime becomes more intense than the nominal-one, the centerbody should be pulled out of the intake (the distance DD$^{'}$ has become negative), to keep the shock-waves outside the intake.

As long as the position of D$^{'}$ - point on the shock-wave depends on the waves angle, which, in turn, depends on the flight Mach number, it leads to the dependence of the DD$^{'}$-distance on the flight regime (flight Mach number). Centerbody's displacement with respect to the flight Mach number represents the inlet's control law; its graphical expression being depicted in Fig. 7, where the length x_{cb} represents the distance (measured on the *x*-axis) between the cowl's lip, D-point, and the centerbody's tip, A-point. An alternative control law would be the one which assures the DD$^{'}$-distance cancellation by translating the entire intake's cowl while the centerbody position is kept fixed. In fact, the longitudinal displacement of the centerbody and/or of the intake's cowl are the only means for axisymmetric inlets tuning with respect to the flight regime (Mach number).

As Fig. 7 shows, the control law has three stages:

a) stage I, corresponding to the low supersonic flight speeds, when the flight Mach number is under $M_H^{'} = 1.598$ and the centerbody's tip triggers a detached normal shock-wave.

Centerbody's position is fixed, the distance x_{cb} being constant $(x_{cb}=0.172)$. In fact, this might be the centerbody's position even for subsonic flights;

b) stage II, corresponding to the medium supersonic flight speeds, when the Mach number is between $M_H^{/}=1.598$ and $M_H^{//}=2.157$. The centerbody's tip triggers the first conical shock-wave, while the centerbody's second conical section triggers a detached normal shock-wave. Just as in the first stage, centerbody's position is fixed, the distance x_{cb} being constant $(x_{cb}=1.364)$;

c) stage III, corresponding to the high supersonic flight speeds, when the Mach number is bigger than $M_H^{//}=2.157$ and the centerbody triggers both conical shock-waves. The control law is a non-linear-one, described by the polynomial:

$$x_{cb}(M_H)=0.0816\times M_H^4-0.797\times M_H^3+2.5847\times M_H^2-2.617\times M_H+1.307\,. \tag{9}$$

If one chooses to use the cowl displacement instead the centerbody's displacement as inlet's tuning method, the control law is similar.

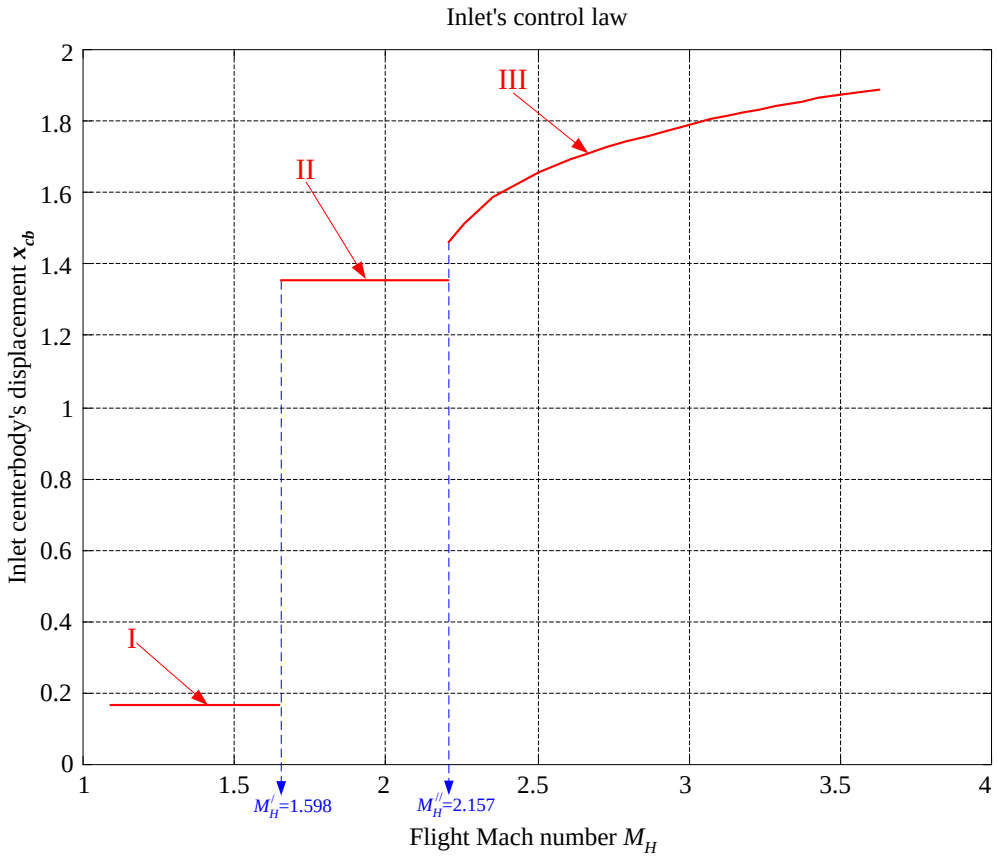


FIG. 7. Inlet's control law (centrbody's displacement)

CONCLUSIONS

Supersonic inlets for aircraft are built in a large range of shapes and sizes, which are usually imposed both by the flight speed of the aircraft and by the position of the inlet on aircraft's airframe. Axisymmetric inlets might be used as frontal inlets: in the front of aircraft's fuselage for single engine aircrafts, or in the front of the nacelle for multi-engine aircrafts (when the nacelles are mounted on the wings or on the fuselage).

Inlet's optimal architecture issuing was made using a supersonic inlet optimization algorithm based on inlet's total pressure recovery coefficient maximization (total pressure of the entire shock-waves system recovery). Main geometric elements of the inlet are: centerbody's flare angles (θ_1 and θ_2), centerbody's panels' lengths (l_1 and l_2), as well as cowl lip's position. All of these elements were determined for a hypothetical fixed geometry inlet, for a nominal frontal Mach number $M_H = 3.3$, the inlet being designed as frontal air intake of a trisonic aircraft.

In order to simplify the architecture, one has chosen the same value θ for both of the flare angles of the centerbody, while the cowl lip's angle was chosen as half of this value. The algorithm applying has as result a graphic dependence of the inlet's pressure recovery coefficient on the θ – value as a curve with maximum value, which gave the optimal value of θ angle. One has chosen the value for the optimal architecture configuration and one has also determined this configuration, consisting of the nodal points coordinates of inlet's scheme.

Based on this configuration one has established the total pressure recovery characteristic, as well as the flow rate characteristic for the studied inlet.

Inlet's control law, consisting of inlet's conical centerbody positioning, with respect to the flight regime, is not a continuous curve (as Fig. 7 shows); it has two discontinuity points, which corresponds to the critical regimes, when the conical shock-waves triggered by the centerbody are to be detached; moreover, it has two flat levels (the first is for low supersonic flight regime, under $M_H^{/}$, the second - for flight regimes between $M_H^{/}$ and $M_H^{//}$), while the third part of the control low is a nonlinear-one, continuously growing with the flight regime.

However, the inlet is sensitive to the engine operating regime's changes too; in fact, engine's regime affects the position of the shock-waves in front of, or inside the intake [5, 8, 10], so other control laws (with respect to aircraft engine's regime) could be issued (as in [10, 11]), but using the same mobile elements (centerbody or intake's cowl), suitable designed in order to assure the desired shape of the internal duct of the air intake.

The paper has studied the architecture and the control law possibilities, but it could be continued with a study concerning possible control systems meant to realize the designed control law(s) and to assure the suitable operation of the inlet.

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AUTOMATIC CONTROL SYSTEM FOR SUPERSONIC INLET'S CENTERBODY'S POSITIONING

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Abstract: *The paper deals with an automatic system meant to control an air inlet designed for a supersonic aircraft. Starting from the system composition and its constructive scheme, the mathematical model was built up and the transfer function was also determined. Mathematical model's coefficients were calculated or estimated based on inlet's control law and on other similar systems coefficients calculation. Some simulation were performed and the stability and the quality of the control system were evaluated, for different flight regimes. The study is useful for similar inlet's control architecture possibilities evaluation.*

Keywords: *supersonic, inlet, centerbody, control, Mach number, actuator, feedback, step response.*

1. INTRODUCTION

Inlet control systems are built up in a wide range of architectures and operational principles, depending on the type of the aircraft which uses it, on the type of the assisted aircraft engine, on the specific inlet architecture, as well as on their specific positioning on the airframe. Such systems, that assist various supersonic inlets, are presented and studied in [1, 11-16]. The possibilities of control for an aircraft supersonic inlet, in order to assure the suitable balance of the engine's necessary air flow rate and, respectively, the inlet's delivered air flow rate, are various, such as: the flow cross-section area's control by the spike or the centerbody positioning [1, 14, 15], respectively by the intake's cowl positioning [14], as well as the inner minimum cross-section area control by the inner diaphragm's positioning [11, 12].

Most of these control systems are based on hydraulic actuators; however, electric actuators are also a reliable alternative, depending on the necessary power for the mobile parts displacement. The above-mentioned control systems are hydromechanical-type, but their transducers and command elements may be hydraulic, pneumatic or even electric.

The inlet control system studied in this paper is a mixed-one, having a hydro-mechanical actuator, pneumatic pressure sensors, as well as electrical programming and command block and feedback converter. These elements are individually or combined studied in [1, 5, 11, 13], for different applications, such as follower systems, feed-back or/and feed-before control systems.

2. INLET CONTROL LAW

The control law for the studied inlet was determined in [15] with respect to aircraft flight regime, consisting of inlet's centerbody's positioning with respect to the freestream in front of the inlet Mach number (which is the same with the flight Mach number for a frontal inlet, mounted in the front of aircraft's fuselage).

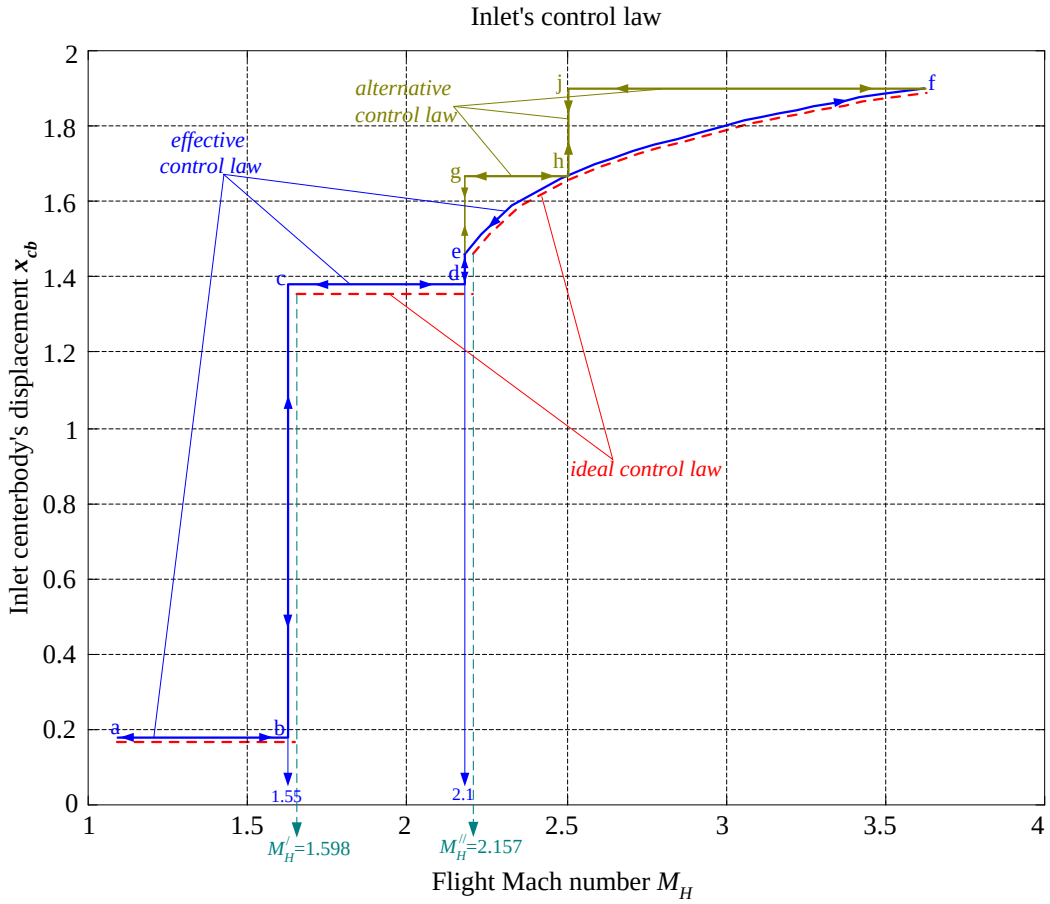


FIG. 1. Inlet's control law possibilities

The theoretical control law, as determined in [15], is graphically depicted in Fig. 1 with red dashed line; it is noteworthy that the law is a discontinuous-one, having two flat zones and and a non-linear zone.

The effective (real) control law, used for the inlet's control (inlet's adapting at various flight regimes), is a little different than the theoretical-one, because of various flight conditions changing and because of a lot of aerodynamic and engine operation constraints. Thus, the effective control law should have a different graphical shape, as depicted in Fig. 1 with continuous blue line (a-b-c-d-e-f).

The effective control law should follow the ideal law, but some differences are to be highlited. Firstly, the flat zones a-b and c-d, as well as the non-linear zone e-f, are developed at higher levels, which means that the centerbody has small extra-displacements, for safety operation. Secondly, in order to avoid the accidentally penetration of the external shock-waves into the air inlet, the "jumps" b-c and d-e must be realized earlier than at the critical Mach numbers $M_H^{/}$ and $M_H^{//}$; in fact, the new jump Mach number values are $M_H^{/}=1.55$ instead 1.598, respectively $M_H^{//}=2.1$ instead of 2.157.

The non-linear zone e-f of the ideal control law may be mathematically described (as presented in [15]) by the formula:

$$x_{cb}(M_H)=0.0816\times M_H^4-0.797\times M_H^3+2.5847\times M_H^2-2.617\times M_H+1.307\,, \tag{1}$$

while the effective law must be translated at bigger values, so the term 1.307 in Eq. 1 becomes 1.315. However, it is difficult to realize this zone with accuracy, so an alternative control law may be issued, as presented in Fig. 1 with continuous green line.

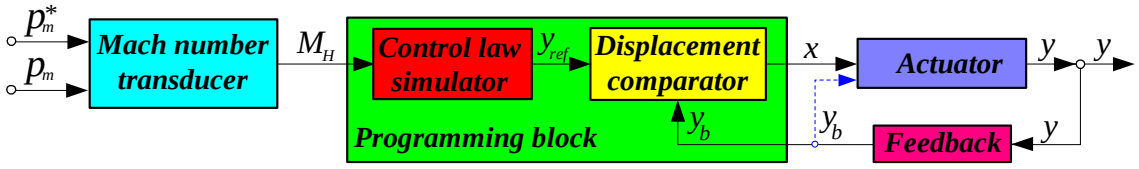


FIG. 2. Inlet's control system operational block diagram

This alternative law must "cover" the non-linear zone, approximating it by two flat zones (g-h and j-f) and an additional "jump" h-j at $M_H^{///} = 2.5$.

3. AUTOMATIC SYSTEM PRESENTATION

Automatic control system operational diagram is depicted in Fig. 2. As presented, the control system consists of: a) the Mach number transducer; b) the programming block ; c) the hydraulic actuator (with or without inner feedback); d) centerbody's position feedback. One has used as input/output signals the formal-ones (such as the Mach number or displacements), while many of the operational blocks are converting these various signals into electric-ones.

The Mach number transducer converts the pressure signals (total pressure p_m^* and static pressure p_m, obtained by Pitot-tube intake) into an electrical signal U_M proportional to the flight Mach number in front of the inlet M_H. Such a transducer, or similar ones, are described and studied in [5, 9, 13]; most of them are included in a much complex aerodynamic system for flight altitude, flight speed (or flight Mach number) and attack angles measuring, which obtains pressure information from an embedded aerodynamic probes network.

This electrical signal becomes the input of the programming block. This block consists of a control law simulator and a comparing block. The control law simulator should give the necessary centerbody displacement y_r, determined with respect to the measured flight Mach number M_H; in fact, the control law simulator use the electrical signal U_M for another electrical signal issuing, the U_{yr} – voltage, which is proportional to the necessary centerbody's displacement y_r. This signal is the input of the displacement comparator, where it is compared to another electrical signal U_y, which is the signal proportional to the realized centerbody's displacement y, converted by the feedback block into an electrical voltage; the result of the comparison $U_{yr} - U_y$ is amplified and then converted by the displacement comparator through a logometric system into a mechanical signal, the displacement x.

This x – displacement becomes the input of the actuator's distributor (slide valve); the actuator needs a high power to displace the centerbody, so it was chosen as hydraulic-type, being supplied by aircraft hydraulic system, or it could have its own pump. The actuator's distributor is a mechanical-one and its displacement x, given by the comparator, is proportional to the centerbody's displacement error. The actuator may have an inner feedback (as presented and studied in [13], highlighted in Fig. 2 by dashed line), or it may have not, the centerbody's position feedback being used only by the comparing block.

4. SYSTEM'S MATHEMATICAL MODEL

A simplified mathematical model of the centerbody's position control system may be obtained if one uses the already determined models for each one of system's parts.

4.1. Mach number transducer's model. The transducer has the main role to determine the value of the flight Mach number, based on aerodynamic information (total and static air-pressure) and to convert it into a voltage signal. Its mathematical model is determined in [5] and has the form

$$\overline{M}_H(\mathrm{s}) = \frac{k_{pt}}{\tau_{MH}\mathrm{s}+1}\overline{p}_m^*(\mathrm{s}) - k_p\overline{p}_m(\mathrm{s}), \tag{2}$$

$$\overline{U}_M(\mathrm{s}) = k_{UM}\overline{M}_H(\mathrm{s}), \tag{3}$$

where k_{pt}, k_p, k_{UM} are gains, τ_{MH} – transducer's time constant with respect to the total pressure, $\overline{M}_H$ – Mach number's dimensionless parameter, $\overline{p}_m, \overline{p}_m^*$ – pressures' dimensionless parameters, $\overline{U}_M$ – transducer's output voltage dimensionless parameter. As presented, the transducer has an aerodynamic block and a converter.

4.2. Programming block model. The programming block consists of two important parts: the control law simulator, which gives the imposed centerbody's displacement with respect to the Mach number, respectively the displacement comparator, which compares the imposed centerbody's displacement to the effective centerbody's displacement and gives the input signal for the actuator's slide-valve.

The control law simulator is, in fact, a block (computer) which calculates the centerbody's displacement with respect to the flight Mach number M_H (using the polynomial (1) and/or the graphics in Fig.1) and supplies the comparator with the U_{yr} – reference voltage, which is proportional to the reference centerbody's displacement y_r (the term x_{cb} in Fig. 1 or in Eq. (1)):

$$\overline{U}_{yr}(\mathrm{s}) = k_{Myr}\overline{U}_M(\mathrm{s}), \tag{4}$$

where $\overline{U}_{yr}$ is the reference dimensionless voltage and k_{Myr} – the gain calculated from the control law, which may be determined as the derivative of the polynomial function which describes the control law.

The displacement comparator block is, in fact, a logometric comparison system, comparing the displacement signal voltage U_y to the reference signal voltage U_{yr}. The algebraic sum $U_{yr} - U_y$ may be positive, negative or zero. The zero sum corresponds to the steady state regime, when the flight Mach number is constant and the centerbody position must be kept the same. For other $U_{yr} - U_y$ values the actuator should become operational and move the centerbody into the suitable direction and with the correct distance.

Displacement comparator's model is a linear-one and may be described as

$$\overline{x}(\mathrm{s}) = k_{Ux}\left[\overline{U}_{yr}(\mathrm{s}) - \overline{U}_y(\mathrm{s})\right], \tag{5}$$

where k_{Ux} is comparator's gain and it is necessary for the signal amplifying, in order to assure enough power and stroke for the distributor's slide-valve.

4.3. Actuator's model. For the hydraulic actuator, without (Eq. (6)) or with rigid feedback (Eq. (6′)), one has determined the model in [13] as follows:

$$k_x\overline{x}(\mathrm{s}) = (\tau_{Ap}\mathrm{s} + \rho_a)\overline{y}(\mathrm{s}), \text{ or} \tag{6}$$

$$k_x\bar{x}(s)-\bar{z}(s)=(\tau_{Ap}s+\rho_a)\bar{y}(s), \tag{6'}$$

where τ_{Ap} is the hydraulic actuator's time constant, ρ_a – actuator's stability constant, $\bar{y}$ – actuator's rod displacement dimensionless parameter, k_x – actuator' slide-valve's gain, $\bar{z}$ – actuator's rigid feedback dimensionless parameter (if the feedback exists).

4.4. Feedback equations. Actuator's rod displacement y must be measured and used as feedback for the programming block. It is very difficult to perform a mechanical measurement, so the feedback uses an electric potentiometer (as described and studied in [5]) which transforms the mechanical signal of the displacement into an electric voltage signal U_y; usually, for small y – displacements, the used potentiometer is a linear-one, but if the displacements have significant values, the used potentiometers may be non-linear (logarithmic), the feedback becomes also non-linear and the programming block's control law simulator must be modified.

$$\bar{U}_y(s)=k_{yU}\bar{y}(s), \tag{7}$$

where k_{yU} is the potentiometer's gain.

Actuator's feedback is a mechanical-one, being realized by a rocking lever (as presented in [1, 13,14]) and its equation is

$$\bar{z}(s)=k_{\rho l}\bar{y}(s), \tag{8}$$

where $k_{\rho l}$ – actuator's rigid feedback gain.

4.5. System's transfer function. Using the above-presented mathematical model's equations, one has built up the block diagram with transfer function, as depicted in Fig. 3.

Based on the above-presented equations, one has determined a simplified form of the mathematical model, which excludes the aerodynamic transducer, considering only the converter, the programming block and the actuator, as follows:

$$\bar{y}(s)=\frac{1}{\tau_a'^{/}s+\rho_a'^{/}}\bar{M}_H(s), \tag{9}$$

System's transfer function $H_M(s)$, with respect to the freestream Mach number (flight Mach number), for an actuator without inner feedback (AWFB), becomes:

$$H_M(s)=\frac{1}{\tau_a'^{/}s+\rho_a'^{/}}, \tag{10}$$

where $\tau_a'^{/}$ – time constant, $\rho_a'^{/}$ – stability constant, their expressions being, as follows:

$$\tau_a'^{/}=\frac{\tau_{Ap}}{k_x k_{Ux} k_{Myr} k_{UM}}, \tag{11}$$

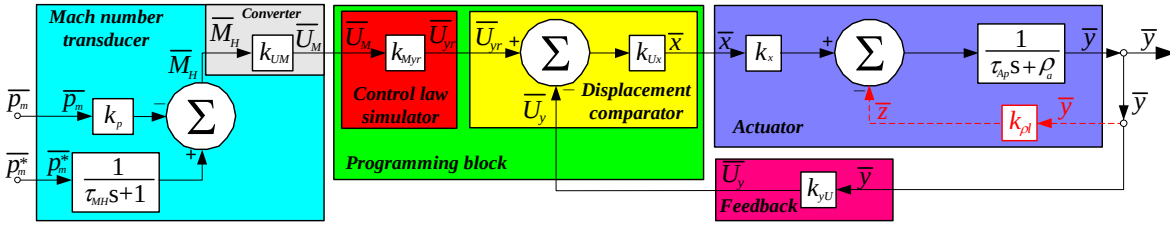


FIG. 3. Inlet's control system block diagram with transfer functions

$$\rho_a^{/} = \frac{\rho_a + k_x k_{Ux} k_{yU}}{k_x k_{Ux} k_{Myr} k_{UM}}. \tag{12}$$

If the actuator has a mechanical inner feedback (AFB, as presented in Fig. 3, red dashed line inside the *Actuator*-block), the transfer function has the same form as in Eq. (10), its time constant has the same expression as in Eq. (11), but the stability constant becomes

$$\rho_a^{//} = \frac{\rho_a + k_{\rho l} + k_x k_{Ux} k_{yU}}{k_x k_{Ux} k_{Myr} k_{UM}} = \rho_a^{/} + \frac{k_{\rho l}}{k_x k_{Ux} k_{Myr} k_{UM}}, \tag{13}$$

which means that the presence of the feedback increases the stability constant value.

5. ABOUT SYSTEM'S STABILITY AND QUALITY

System's transfer function with respect to the flight Mach number is a first order one; its stability is fulfilled if the coefficients $\tau_a^{/}$ and $\rho_a^{/}$ (respectively $\rho_a^{//}$) have the same sign. As far as $\tau_a^{/}$ is a time constant, which is always positive and the quantities involved in $\rho_a^{/}$ and/or $\rho_a^{//}$ expressions are always positive, one may conclude that the system is a stable-one, its stability being asymptotic-type.

System's quality (system's time behavior) shall be estimated using the unitary step input (Heaviside step function as input for the system), which means a hypothetical sudden modifying of the flight Mach number. System's output was considered the actuator's rod displacement dimensionless parameter, which is the same parameter as the inlet's centerbody's positioning. Such a simulation was performed, for both of actuator's options (with or without rigid feedback), for multiple flight situations; one has considered the most important flight regimes: the nominal-one (when $M_H = 3.3$), the intermediate regime ($M_H^{///} = 2.5$), the medium supersonic regime ($M_H^{//} = 2.1$) and the low supersonic regime ($M_H^{/} = 1.55$), that means the nominal regime and the centerbody's repositioning regimes.

System's coefficients were calculated using the control law in Fig. 1 or were estimated using some other studies [1, 11, 12, 14]. Simulation results are presented in Fig. 4.a)…d), corresponding to the above-mentioned flight regimes.

For the most frequently used flight regime (see Fig. 4.a), no matter the actuator architecture, the system stabilizes with static error (4.8% for AFB, 6.3% for AWFB), the values of the settling times being nearly the same, around 3.0 seconds.

For an intermediate supersonic flight regime, the asymptotic aperiodic stabilization maintains; both static errors are growing (7.3% for AFB, 9.8% for AWFB), while the settling time has a small increasing (around 3.3 seconds).

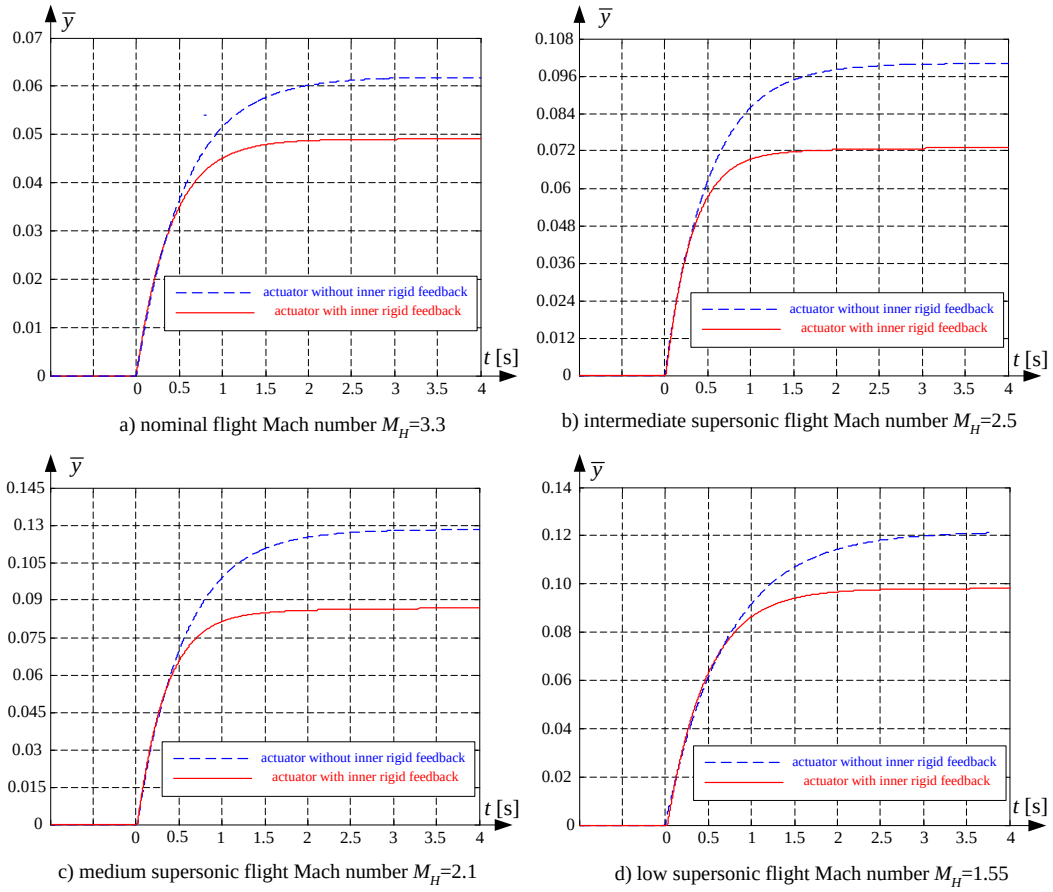
If the flight regime becomes less intense ($M_H^{//} = 2.1$), the trends are maintaining, so the static errors become 8.8% for AFB and 12.8% for AWFB, while settling time values become 3.3 seconds for AFB, respectively 3.5 seconds for AWFB.

When the aircraft flies at low supersonic regime ($M_H^{/} = 1.55$), control system has the same behavior, but bigger static errors (9.8% for AFB, 12.2% for AWFB), while the settling times are the biggest (3.6 seconds for AFB, respectively 3.8 seconds for AWFB).

CONCLUSIONS

One of nowadays most important issues of the high speed flights is how to obtain the necessary thrust, which needs special thermo-hydro-dynamic conditions.

These conditions concern the maintenance of pressure and air density inside the engine, no matter the flight regime, condition very difficult to be accomplished as long as the flight regime parameters vary in a wide range of values. The necessary air mass flow rate for the engine of an aircraft is ensured by engine's inlet; if supersonic, its architecture and operation mode are all the more important. In fact, the inlet is the connector between engine air necessities and the available air mass flow rate and acts like an interface.



a) nominal flight Mach number M_H=3.3

b) intermediate supersonic flight Mach number M_H=2.5

c) medium supersonic flight Mach number M_H=2.1

d) low supersonic flight Mach number M_H=1.55

FIG. 4. Control system's step response for different flight regimes

Control law, consisting of inlet's spike positioning with respect to the flight regime, is not a continuous curve (as Fig. 1 shows); it has two or three discontinuity points, which corresponds to the critical regimes (when the conical shock-waves are to be detached) and two flat zones, as well as a non-linear zone.

For all flight regimes the control system is an asymptotic stable-one, presenting an aperiodic behavior, because of its first order transfer function.

The system is a static-one, its static errors having acceptable values (from 4.8% to 12.8%), the smaller values being obtained when an actuator with inner feedback is used; system's settling time has also acceptable values, around 3.0 s for high flight speeds and around 3.8 s for low flight speeds, which proves that the system has a better behavior at high flight speeds. From the stability and quality points of view, the chosen control system has obtained acceptable performances (static errors and settling time values) in the entire flight regimes range.

A similar study may be performed if one considers both the aerodynamic transducer and the electric converter as Mach number estimators; consequently, the system will have two inputs (the static and the total pressure parameters), two transfer functions and both of these transfer functions will have a second order characteristic polynomial, in which case the stability and quality studies become more complicated.

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ON-BOARD STATE-OF-CHARGE ESTIMATION OF LI-ION BATTERY IN HYBRID ELECTRIC AIRCRAFT VEHICLES USING STATE ESTIMATORS – CASE STUDY

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Abstract: *A mature and comprehensive battery management system in hybrid electric aircraft vehicles is an essential component that performs many functions, among which the ground power, emergency power, improved DC bus stability, and fault detection, diagnosis and isolation are some of them. The selection criterion of the battery type depends on several characteristics, such as weight, power density, cost, size, life cycle, battery state-of-charge, and maintenance. Related to this, the lithium-ion battery is the best choice for hybrid electrical aircraft vehicles due to its higher-capacity and the great capability to hold and distribute large power. The upcoming advancement in lithium-ion batteries technologies is lithium-air batteries. They have a higher energy density since the oxygen is a lighter cathode and a freely available resource. The lithium-ion battery state-of-charge is an important internal parameter that cannot be measured directly, so its estimation remains an essential task for battery management system. In this research work we disseminate some of our preliminary results, especially in modeling and state and parameter estimation techniques applied also on state-of-charge estimation of the rechargeable batteries of different chemistry. More precisely, we investigate the design and the effectiveness of two nonlinear state-of-charge estimators implemented in a real-time MATLAB environment for a particular lithium-ion battery, such as an adaptive extended Kalman filter and a nonlinear observer. Finally, our target to be reached is to find among these two estimators the most suitable one in terms of its estimation accuracy, convergence speed and robustness.*

Keywords: *EMC Li-Ion battery model, battery management system, battery state-of-charge, adaptive extended Kalman filter, state estimator observer.*

1. INTRODUCTION

One of the main reason to push the aviation industry toward hybrid electric aircraft vehicles (HEAVs) is to cut carbon emissions produced by aircrafts. *National Geographic* reported in April 2015 that "*airplanes contributed 700 million metric tons of carbon dioxide to the air in 2013.The number, if changes do not occur, is set to triple by 2050*", as is mentioned in [1]. Thus, the environmental impact is a key issue on the enhancing the battery technologies, as is mentioned also in [1]. The selection criterion of the battery type depends on several characteristics, such as weight, power density, cost, size, life cycle, battery state-of-charge, and maintenance. Nowadays, the lithium-ion (Li-Ion) batteries is the most promising technology and also the best choice for hybrid electric air vehicles (HEAVs). Furthermore, considerable advances in unmanned air vehicle (UAV)/drone technology have created a need for small lithium batteries that "*can pack large amounts of power into very small spaces*", as is mentioned in [2]. Let's why the design engineers are continually seeking "*to make UAVs smaller and lighter to benefit aerodynamics and range of flight*" [2].

Typically, large UAVs which utilize gasoline engines are equipped with lithium batteries "*to reduce size and weight when powering specific sensor or instrumentation platforms or for emergency backup power requirements*" [2]. As is stated in [2] the lithium metal oxide batteries "*deliver a nominal voltage of 4 V, and a discharge capacity of 135 to 500 mAh, capable of handling 15A pulses*". They are based on a technology consisting of a carbon-based anode, multi-metal oxide cathode, organic electrolyte, and use a shut-down separator for enhanced safety, and are capable also to "*feature an extremely low self-discharge and a wide operating temperature range (-40° to 85°C)*", as is mentioned in [2]. Let's the reason why an UAV intended for unmanned air reconnaissance activities is using lithium metal oxide batteries to "*create smaller, lighter battery packs for the emergency recovery system, which enables the aircraft to glide to a safe landing in case of a catastrophic system failure*" [2].

NASA and Airbus are leading the way in cleaner aviation by designing purely electric or HEAVs. Moving toward electric/hybrid electric aircraft vehicles requires creating new aircraft designs as well as propulsion systems that integrate battery technologies with more efficient engines [1]. NASA is studying the Boeing 737-size hybrid turbo-electric powered airliner, "*more efficient aircraft that combines turbine engines with generators to distribute power to electrically driven propulsors*", as is mentioned also in [1]. For readers information a Li-Ion battery pack that powers the aircraft motors "*is comprised of 2982 cells with a capacity of 2.8 amperes per hour each*" [1].

All the batteries no matter their chemistry should comply also with the international standards specs for "*vibration, shock, temperature shock, salt fog, altitude, acceleration, spinning, crush, impact, nail penetration, heat, overcharge, and short circuit*", as is mentioned also in [2]. The upcoming advancement in Li-Ion batteries technologies is lithium-air batteries, that will have a higher energy density due to oxygen being a lighter cathode and a freely available resource [1]. A mature and comprehensive battery management system (BMS) in HEAVs is an essential component that performs many functions, such as ground power, emergency power, improved DC bus stability, and fault detection, diagnosis and isolation are some of them [3]. The Li-Ion battery state-of-charge (SOC) is one of the most important internal parameter that cannot be measured directly, so its accurate estimation is an important task for BMS to prevent the dangerous situations when the battery is over-charged or over-discharged, and to improve significantly the battery performance [1]. The battery SOC is an inner state of a battery defined in [3-5] as the available capacity of a battery, more precisely as a percentage of its rated capacity. The Li-Ion battery SOC estimation approach in our research paper is model based on the values of all the available and measurable Li-Ion battery parameters, such as current, battery terminal voltage, and temperature. Thus, we propose two Li-Ion battery SOC estimators, namely an adaptive extended Kalman filter [3-5] and an adaptive nonlinear observer estimator (NOE) [6], the both of them implemented in real-time MATLAB R2017a simulation environment.

2. LI-ION BATTERY MODEL SELECTION

The OCV-R-RC-RC-RC electrical circuit model shown in **Fig.1**, known as the third order 3RC EMC Li-Ion battery model, is one of the simplest equivalent model circuits (EMC) that is selected to approximate the electrical performance of the Li-Ion battery. It consists of 3 main parts: (1) OCV source, (2) internal battery resistance representing the ohmic resistance, and (3) three parallel RC polarization cells (Resistors – Capacitors).

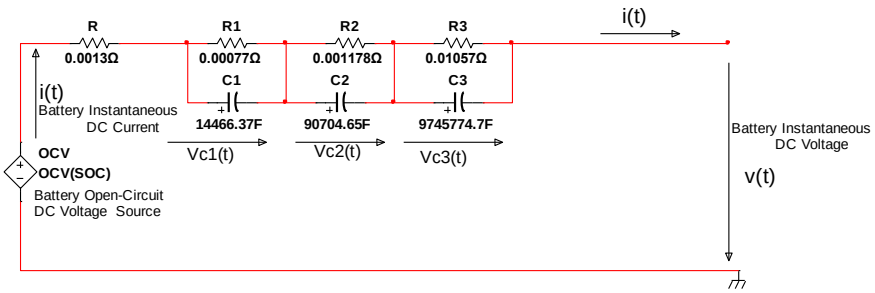

FIG.1. The 3RC EMC Li-Ion Battery electrical circuit model in National Instruments Multisiom 14 editor

The Li-Ion battery cell performance deteriorates over time whether the battery is used or not, known as "cycle fade", and "calendar fade" respectively. Several disturbances and unwanted chemical changes inside the battery, the temperature and pressure effects, repeated charging and discharging cycles rates, the battery overcharging and over discharging limits, battery cell aging effects, battery SOC, coulombic efficiency, loss of electrolyte, battery internal and insulation resistances, and so on affect considerable the Li-Ion battery dynamics in a realistic operating conditions environment. Since, for simulation purpose, we investigate a simplified model of the battery cell dynamics, with constant parameters, unaffected in time by the battery SOC and temperature effects, in addition we test in the following sections the robustness of the both proposed SOC estimators to all these factors that change considerable the values of battery model parameters during its operation. Furthermore, a specific setup for the proposed third order 3RC EMC Li-Ion battery model constant parameters is under investigation to prove the effectiveness of both proposed battery SOC estimation strategies, such those shown in [6], Table 5.4, p.100 where the values of the battery parameters are specified at the room temperature (i.e. 25°C). Since in "*real life*" the dynamics of the battery is seriously affected by temperature, an improvement is done by considering a collection of three 3RC Li-Ion batteries whose the optimal values of the parameters are extracted for three different temperatures (5°C, 15°C and 20°C) as is shown in [7], Table 3.1, p.51, that can be updated dynamically based on a thermal model described also in [7]. Moreover, the reason to make this EMC battery model selection is to benefit of its simplicity and ability to capture accurately the entire dynamics of Li-Ion battery, as well as its easy real-time implementation with acceptable range of performance [8]. Also, "*this choice is due to the early popularity of BMS for portable electronics, where the approximation of the battery model with the proposed EMC is appropriate*", as is mentioned in [9]. In addition, it is worth to mention that this model is applied today for many other similar energy storage applications [9]. However, in this research paper we are more interested in the "*proof concept*" algorithmic considerations as motivated by the requirements imposed by the environment and the vehicle [10]. This battery model selection choice gives us more flexibility to prove the effectiveness of the proposed Li-Ion battery SOC estimators in terms of SOC estimation accuracy, speed convergence, robustness to different changes in battery model parameters (i.e. internal resistance, battery capacity affected by aging degradation and repeated charging and discharging cycles) and to current sensor level noise, similar as is done in [10]. We are focused also on real time implementation simplicity in MATLAB R2017a simulation environment. The electrical circuit model is relatively accurate to capture the dynamic circuit characteristics of a battery cell, such as the open-circuit voltage, terminal voltage, transient response, and self-discharge, as is mentioned also in [10]. However, since in "*real life*" the battery dynamics is seriously affected by the temperature efects and changes in battery SOC on the model parameters remains for us an interesting open research field direction to be investigated in the future work.

3. LI-ION BATTERY MODEL DYNAMICS IN DISCRETE TIME STATE SPACE REPRESENTATION

The discrete time state space model that describes the dynamics of the Li-Ion battery is similar introduced as in [6-7, 10-11] as follows

$$
\begin{aligned}
&x(k+1) = A(k)x(k) + B(k)u(k)\\
&y(k) = C(k)x(k) + D(k)u(k) + \Phi(k, x_4(k))\\
&x(k) = \begin{bmatrix} x_1(k) & x_2(k) & x_3(k) & x_4(k) \end{bmatrix}, A = \begin{bmatrix} 1-\frac{T_s}{T_1(k)} & 0 & 0 & 0\\ 0 & 1-\frac{T_s}{T_2(k)} & 0 & 0\\ 0 & 0 & 1-\frac{T_s}{T_3(k)} & 0\\ 0 & 0 & 0 & 1 \end{bmatrix}, B = \begin{bmatrix} \frac{T_s}{C_1}\\ \frac{T_s}{C_2}\\ \frac{T_s}{C_3}\\ -\frac{\eta T_s}{C_{nom}} \end{bmatrix}\\
&C = [-1 \ -1 \ -1 \ K_2], D = -R
\end{aligned}
\tag{1}
$$

$$
\begin{aligned}
&\Phi(k, x_4(k)) = K_0 - K_1\frac{1}{x_4(k)} + K_3\ln(x_4(k)) + K_4\ln(|1-x_4(k)|) \ , x_4(k) = SOC(k)\\
&OCV(k, x_4(k)) = K_0 - K_1\frac{1}{x_4(k)} - K_2x_4(k) + K_3\ln(x_4(k)) + K_4\ln(|1-x_4(k)|) \ , x_4(k) = SOC(k)
\end{aligned}
\tag{2}
$$

where T_s is the samling time, $t = kT_s, k \in Z$, $\Phi(k, x_4(k))$ denotes a nonlinear function of SOC, $x(k) = x(kT_s)$ is the battery model state vector, $y(k) = y(kT_s)$ is the battery terminal output voltage, $u(k) = u(kT_s)$ denotes the battery current input, and the polarization time constants of the battery RC cells are given by $T_1(k) = R_1(k)C_1(k), T_2(k) = R_2(k)C_2(k), T_3(k) = R_3(k)C_3(k)$. Also, $OCV(k, x_4(k))$ as a nonlinear function on SOC, denotes the open-circuit voltage of the proposed Li-Ion battery. The model parameters are set to the same values used in [6], Table 5.4, p.100, based on the assumption that the parameters are time constant and independent on the battery SOC changes and temperature effects. In addition, the values of these parameters differ for charging and discharging cycles, as well as the coloumbic efficiency, thus the cell's voltage behavior will be described by two sets of parameters, one for charging and one for discharging, as is shown in [6-7, 10]. In a realistic environment of operating conditions the battery's parameters are variable with respect to the temperature, the SOC and the current direction, making the overall Li-Ion battery one nonlinear model nonlinear. As is stated in [4-7, 10], experimental data and curve fitting techniques are used to find empirical equations relating the parameters with the operating conditions. The Li-Ion battery model can be simplified as is done in [7-10], the simplifying model procedure details can be found in [7], pp.45 – 46, and also used in [10]. For simulation purpose, we combine this procedure with the new modeling approach introduced in [7], pp. 46-50, based on the internal impedance measurements that dynamically update the model based on cell temperature and SOC variations, thus the dynamic battery behavior may be more accurately predicted.

This is possible "*since the internal battery impedance is inverse proportional to its temperature*", as is mentioned in [7, 10]. Also, "*the effects of SOC variation is only taken into account to update the OCV parameter*" [7].

In our approach all three RC polarization cells parameters are not updated for SOC variations since "*they are minimally affected at a frequency of interest*" in HEAVs, as is stated in [7]. To build the third order 3RC EMC Li-Ion battery model the designer can follow the design procedure as is detailed in [7]. Based on this procedure in [7], p.50 – Table 3.1**,** we can find all the values of the extracted battery model parameters corresponding to four different temperatures: $5°C, 10°C, 15°C, 20°C$, shown also bellow in Table 1. A 3RC EMC combined model is well developed in [10] using the same values for the coefficients K_0, K_1, K_2, K_3, K_4 that appear in the Equation (2) and given in [6], Table 5.4, p.100. The tuning values of model parameters $(K_0, K_1, K_2, K_3, K_4)$ are chosen to fit the model to the manufacture's data by using a least squares curve fitting identification method OCV = *h* (SOC), as is shown in [4-5] and mentioned also in [10], where the OCV curve is assumed to be the average of the charge and discharge curves taken at low currents rates from fully charged to fully discharged battery.

Table 1-The Li-Ion 3RC EMC model parameters ([7])

Li-Ion Battery Parameter	**Temperature [$^{\circ}C$]**				**Unit**
	5	10	15	20	mΩ
R	8	8.1	7.5	7.6	
R_1	4.3	4.1	1.9	1.8	mΩ
R_2	5.5	3.5	2.5	1.8	mΩ
R_3	10	7.5	5.1	3.2	mΩ
C_1	0.4	0.4	0.3	0.3	F
C_2	4.3	4.1	4.1	4	F
C_3	49.8	35.3	3.9	35.1	F

3RC EMC Li-Ion battery validation model

Since we don't have specific driving tests for HEAVs, for the selected third order 3RC EMC validation purpose we compare the results of the tests using a particular battery integrated in an Advanced Vehicle Simulator (ADVISOR) MATLAB platform, developed by US National Renewable Energy Laboratory (NREL) [12]. The NREL Li-Ion battery model approximates with high accuracy the Li-Ion battery model 6Ah and nominal voltage of 3.6V, manufactured by the company SAFT America, as is mentioned also in [11 - 12]. Moreover, the proposed third order 3RC EMC Li-Ion battery model can be easily incorporated in a BMS' HEAVs, and its performance is compared to those obtained by a particular HEV that uses a Li-Ion battery pack, tested at different driving speed cycles for a large collection of cars provided by the ADVISOR US Environmental Protection Agency (EPA) that can be easily extended in HEAVs applications, e.g. an Urban Dynamometer Driving Schedule (UDDS), as is shown in Fig. 2 [10].

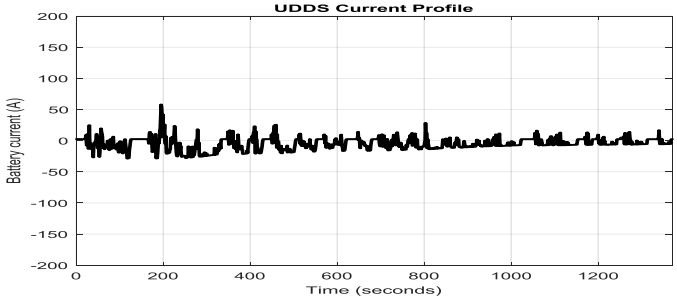

FIG.2. The UDDS current profile cycle Li-Ion battery test

The Li-Ion battery OCV as function of battery SOC full charging cycle (i.e. from 0% to 100% at 1C rate charging cycle) given in Equation (2) is represented in **Fig.3.**

It is usually used to describe the dynamics of Li-Ion battery combined models, as those developed in [4-6, 10], as well as to predict more accurately the Li-Ion battery terminal voltage.

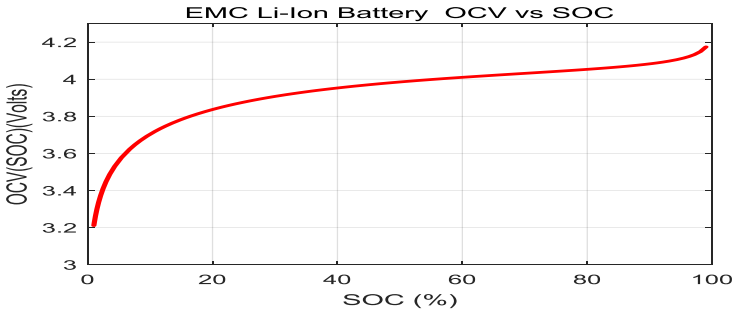

FIG.3. The Li-Ion battery 3RC EMC OCV as function of corresponding battery SOC full charging cycle (i.e. from 0% to 100% @1C-rate charging cycle corresponding to -6A battery constant current)

The corresponding curves of Li-Ion battery SOC (3RC EMC model and ADVISOR MATLAB platform estimate) and for battery terminal voltage are represented for an UDDS driving cycle current profile test in Fig. 4, that validate undoubtedly with a high SOC estimation accuracy (top) the 3RC EMC Li-Ion battery proposed model.

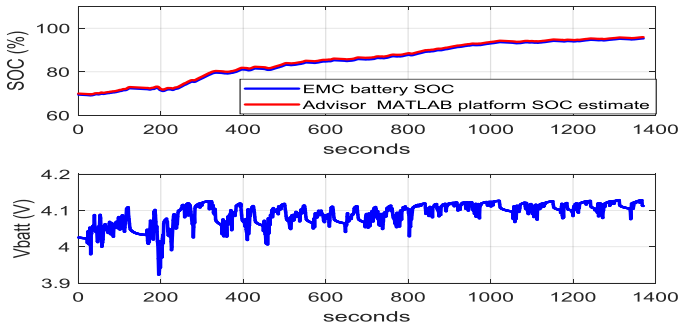

FIG.4. The Li-Ion 3RC EMC battery SOC and ADVISOR SOC estimate for an UDDS cycle current profile test (top) and the corresponding battery terminal voltage (bottom)

4. LI-ION BATTERY SOC ESTIMATORS

In this section we develop two real time SOC estimators for the proposed 3RC EMC Li-Ion battery model described in state space representation in section 3. The first estimator, detailed also in [8], is an improved version of an extended Kalman filter (EKF), well documented in [4-6] and suggested also in [10], such that to estimate the Li-Ion battery SOC much accurately. The second SOC estimator is a nonlinear observer described in detail in [9] that is more simple to be implemented in real-time compared to the one described in [13].

4.1 Adaptive Extended Kalman Filter Li-Ion battery SOC estimator

The Coulomb counting method is a widely-used approach for the SOC estimation and its real time implementation, as is stated in [4-5]. The main drawbacks of this method is that it cannot guess the initial battery SOC value, thus the SOC estimation error is accumulated over time, thus a calibration of Li-Ion battery SOC is needed based on the its OCV measurement.

However, it is very hard to measure the battery OCV in real time and consequently a small OCV error may lead to a significant battery SOC difference, as is stated in [7]. It is the main reason that in this research work, a viable alternative to EKF SOC estimator, namely an adaptive extended Kalman filter (AEKF) Li-Ion battery SOC estimator is implemented to estimate in real time the Li-Ion battery SOC that can be easily extended to HEAVs applications.

In addition, the AEKF SOC real time estimator combines the advantages of the Coulomb counting method and the Li-Ion battery OCV calibration SOC estimation method. More precisely, the AEKF SOC estimator is an EKF developed in details in [4-5] with the performance improved in [8]. In the same way as for EKF the noises and errors are taken into consideration in AEKF SOC estimator gain computation to obtain the optimal SOC estimation results. Since in a Li-Ion battery pack the parameters are extracted once and used in the later estimations, an accumulated modelling error is generated. The novelty of the improved version AEKF SOC estimator is the use of "*a fading memory factor to increase the adaptiveness for the modelling errors and the uncertainty of Li-Ion battery SOC estimation, as well as to give more credibility to the measurements*", as is stated in [8]. When process errors and measurement output noises are considered, the discrete-time state space equation of the 3RC EMC Li-Ion battery dynamic model given in (1), and (2) can be generalized as:

$$\begin{aligned} x(k+1) &= f(k, x(k), u(k)) + w(k) \\ y(k) &= g(k, x(k), u(k)) + v(k) \end{aligned} \tag{5}$$

where $x(k) = \left[x_1(k)\ x_2(k)\ x_3(k)\right]^T$ is a row battery state vector, and the process $w(k)$ and measurement output $v(k)$ are white uncorrelated noises of zero mean and covariance matrices $Q(k)$ and $R(k)$ respectively [4-5, 8, 10, 13], i.e.

$$\begin{aligned} &w(k):\ (0, Q(k)), v(k):\ (0, R(k)) \\ &E(w(k)w(j)^T) = Q(k)\delta_{kj}, E(v(k)v(j)^T) = R(k)\delta_{kj} \\ &\delta_{kj} = \begin{Bmatrix} 0, & k \neq j \\ 1, & k = j \end{Bmatrix} \end{aligned} \tag{6}$$

The AEKF algorithm procedure is suggested by [8, 10] and is summarized as follows.

- **Linearization** - the 3RC EMC Li-Ion battery nonlinear dynamics is linearized around the most recent estimation state value $\hat{x}(k \mid k)$ and $\hat{x}(k \mid k-1)$ respectively, considered as an operating point, and the Jacobian matrices of the linearization are given by

$$\begin{aligned} A(k) &= \frac{\partial f(k, x(k), u(k))}{\partial x(k)} |_{\hat{x}(k|k)}, B(k) = \frac{\partial f(k, x(k), u(k))}{\partial u(k)} |_{\hat{x}(k|k)} \\ C(k) &= \frac{\partial g(k, x(k), u(k))}{\partial x(k)} |_{\hat{x}(k|k-1)} \end{aligned} \tag{7}$$

- **Initialization** - the 3RC EMC Li-Ion battery state vector $x(0)$ is estimated as a Gaussian random vector with mean $\hat{x}(0) = E\{x(0)\}$ and state covariance matrix $\hat{P}(0) = E\{(x(0) - \hat{x}(0))(x(0) - \hat{x}(0))^T\}$, i.e. $x(0):\ N(\hat{x}(0), \hat{P}(0))$.

- **Prediction phase** - the predicted value of the state vector is calculated based on the previous state estimate and the state matrix covariance affected by a fading memory coefficient α

$$\begin{aligned} \hat{x}(k+1 \mid k) &= A(k)\hat{x}(k \mid k) + B(k)u(k) \\ \hat{P}(k+1 \mid k) &= A(k)\hat{P}(k \mid k)A(k)^T + \alpha^{-2k}Q(k) \end{aligned} \tag{8}$$

- **Kalman estimator gain computation**:

$$K(k) = \alpha^{2k}\hat{P}(k+1 \mid k)H(k)^T(H(k)\alpha^{2k}\hat{P}(k+1 \mid k)H(k)^T + R(k))^{-1} \tag{9}$$

- **Correction phase** - the estimated 3RC EMC Li-Ion battery state can be updated any time as long as an output measurement is available

$$\hat{x}(k+1|k+1)=\hat{x}(k+1|k)+K(k)(y(k)-g(\hat{x}(k+1|k),u(k),k)$$
$$\hat{P}(k+1|k+1)=(I-K(k)H(k))\hat{P}(k+1|k)\,(I-K(k)H(k))^{T}+\alpha^{-2k}K(k)R(k)K(k)^{T} \quad (10)$$

The recursive predictor-corrector structure of AEKF estimator allows the time and measurement updates at each iteration. The AEKF SOC estimator has only four parameters to be tuned, namely the noise covariance matrices $Q(k)$ and $R(k)$, the initial value of the state covariance matrix $\hat{P}(0)=\hat{P}(0|0)$, and the fading memory factor α. The tuning values of the AEKF SOC estimator are obtained by a trial and error procedure based on designer's empirical experience. Furthermore, we simplify the tuning parameters procedure such that it doesn't affect the AEKF algorithm convergence, and thus the battery SOC estimation accuracy, by choosing the noise covariance matrices $Q(k)$ and $R(k)$ as positive definite diagonal matrices [8, 10]. For simulation purpose, to prove the effectiveness of the AEKF estimator in terms of convergence speed, accuracy and robustness, we set up the filter parameters for the following values

$$x(0)=[0.01\ \ 0.01\ \ 0.01\ \ 0.7]^{T}, R(0)=[0.02], Q(0)=\begin{bmatrix}0.0002 & 0 & 0 & 0\\ 0 & 0.0002 & 0 & 0\\ 0 & 0 & 0.0002 & 0\\ 0 & 0 & 0 & 0.05\end{bmatrix},$$
$$P(0)=\begin{bmatrix}0.01 & 0 & 0 & 0\\ 0 & 0.01 & 0 & 0\\ 0 & 0 & 0.01 & 0\\ 0 & 0 & 0 & 100\end{bmatrix}, \hat{x}(0)=[0.01\ \ 0.01\ \ 0.01\ \ 0.3]^{T}, x_{EMC}(0)=[0.01\ \ 0.01\ \ 0.01\ \ 0.7]^{T}, \quad (11)$$
$$SOC_{ADVISOR}(0)=0.7, \alpha=1.04$$

4.2 Nonlinear observer SOC estimator

In this subsection, a nonlinear observer estimator (NOE) of Li-Ion battery SOC is under consideration. It is proposed to be an alternative to AEKF SOC estimator as a suitable choice of a new Li-Ion battery SOC real time estimator. To build and implement the second Li-Ion battery SOC estimator in an attractive real time MATLAB R2017a simulation environment we follow the same design procedure as those presented in [9]. The battery SOC estimator design idea is suggested by its linear dynamics structure described in state space through a matrix compact equation given in (1), where all three state variables $x_1(k), x_2(k), x_3(k)=SOC(k)$ change independently. The observer state estimators are model based, widely used in state estimation applications to eliminate the state estimation error using deviation feedback, as is mentioned in [9]. Theoretically, the most of existing linear and nonlinear observers use for SOC estimator structure design the estimation error between the measured battery terminal DC voltage value and its corresponding estimate value that is multiplied by some calculated observer gains L_k such that to correct the dynamics of all estimated states, as follows:

$$\hat{x}(k+1)=A\hat{x}(k)+Bu(k)+L_k(y(k)-\hat{y}(k)),$$
$$L_k=\begin{bmatrix}l_{1k} & l_{2k} & l_{3k} & l_{4k}\end{bmatrix}^{T}, \hat{x}(k)=\begin{bmatrix}\hat{x}_1(k) & \hat{x}_2(k) & \hat{x}_3(k) & \hat{x}_4(k)\end{bmatrix}^{T}=[\hat{V}_{C_1}\ \ \hat{V}_{C_2}\ \ \hat{V}_{C_3}\ \ SOC]^{T}, \quad (12)$$
$$\hat{y}(k)=\hat{V}_{batt}=VOC(SOC)-\hat{x}_1(k)-\hat{x}_2(k)-\hat{x}_3(k)-Ru(k)$$
$$e_{x_1}(k)=e_{V_{C_1}}(k)=x_1(k)-\hat{x}_1(k), e_{x_2}(k)=e_{V_{C_2}}(k)=x_2(k)-\hat{x}_2(k), e_{x_3}(k)=e_{V_{C_3}}(k)=x_3(k)-\hat{x}_3(k), e_y=y(k)-\hat{y}(k)$$

The particular structure of third order 3RC EMC Li-Ion battery model reveals that the output estimation error e_y is mainly caused by an inaccurate SOC estimated value, as is stated also in [9]. Subsequently, only the SOC state estimate from fourth differential equation (1) will be affected, i.e. the observer gains vector becomes:

$$l_{1k}=0, l_{2k}=0, l_{3k}=0,\ l_{4k}\neq 0 \quad (13)$$

This "*outcome improves significant the NOE SOC estimation accuracy and simplifies the structural complexity of the proposed nonlinear observer estimator*", as is stated in [9]. Thus, the dynamics of the NOE estimation errors can be described by the following differential equations [9]:

$$\begin{aligned} e_{x_1}(k+1) &= (1-\frac{T_s}{T_1})e_{x_1}(k) \\ e_{x_2}(k+1) &= (1-\frac{T_s}{T_2})e_{x_2}(k) \\ e_{x_3}(k+1) &= (1-\frac{T_s}{T_3})e_{x_3}(k) \\ e_{SOC}(k+1) &= e_{x_4}(k) = l_{4k}e_y(k) \end{aligned} \tag{14}$$

In [9] is proved that all four states estimation errors described by the system of equations (14) converge asymptotically to zero in steady-state, and the observer gain for the new simplified structure is approximated by an adaptive law:

$$l_{4k} = l_{40} + \alpha e^{\beta(|e_y|)},\ l_{40} > 0, \alpha < 0, \beta < 0 \tag{15}$$

that allows the value of l_{4k} to change dynamically according to the deviation between the measured battery output DC voltage and its corresponding 3RC EMC battery terminal output DC estimated voltage. In Equation (15), l_{40}, α and β are tuning parameters designed to adjust the adaptive property of the gain l_{4k}. The adaptation law convergence rate (15) mainly is determined by l_{40} at first "inaccurate" stage, and the coefficients α and β are used to adjust observer gain l_{4k} when the SOC state estimation also reaches "accurate" stage, as is stated in [9]. In [9] are stated also three assumptions to tune the values of 3RC EMC NOE parameters l_{40}, α and β:

- $l_{40} \geq 0$ to ensure the stability of the proposed NOE;
- The value of l_{40} should be big enough to ensure a fast convergence rate;
- The l_{40} should be small enough to avoid SOC estimation "jitter" effect.

By extensive simulations performed in a real-time MATLAB R2017a simulation environment the all three requirements are met if the NOE parameters l_{40}, α and β are tuned for the following values: $l_{40} = 3$, $\alpha = -0.01$, and $\beta = -100$. The simulation results on the estimation performance of Li-Ion EMC-NOE are shown in next Section 5.

5. REAL-TIME ESTIMATORS IMPLEMENTATION-MATLAB RESULTS AND COMPARISON

In this section we show the simulation results of real time implementation of the both proposed Li-Ion battery SOC estimators, namely AEKF and NOE Li-Ion battery SOC real time estimators. Also, a comparison of the their performance in terms of convergence speed, SOC estimation accuracy, robustness to changes in initial SOC value, changes in measurement sensor noise level, and changes in the battery internal resistance and nominal capacity.

5.1 Real time implementation of the Adaptive Extended Kalman Filter SOC estimator in MATLAB R2017a simulation environment

In this section we show the simulation results of real time implementation of the both proposed Li-Ion battery SOC estimators, namely AEKF and NOE Li-Ion battery SOC real time estimators, to a discharging UDDS current profile test shown at the end of Section 5.2 in the last figure, more precisely in **Fig.30**.

Also, a comparison of the their performance is done in terms of convergence speed, SOC estimation accuracy, robustness to changes in initial SOC value, changes in measurement sensor noise level, and changes in the battery internal resistance and nominal capacity. The simulation results of AEKF real time estimator for the proposed 3RC EMC Li-Ion battery model parameters settings at room temperature during an UDDS discharging cycle current profile test are shown in **Fig.5** to **Fig. 7**. The simulation results from **Fig.5** reveal a very good SOC estimation accuracy between true SOC value and AEKF and ADVISOR SOC estimates, and also validate undoubtedly the proposed 3RC EMC Li-Ion battery model. For visibility purpose, in **Fig.6** is shown almost the same information as in **Fig.5** but without the ADVISOR SOC estimate value.

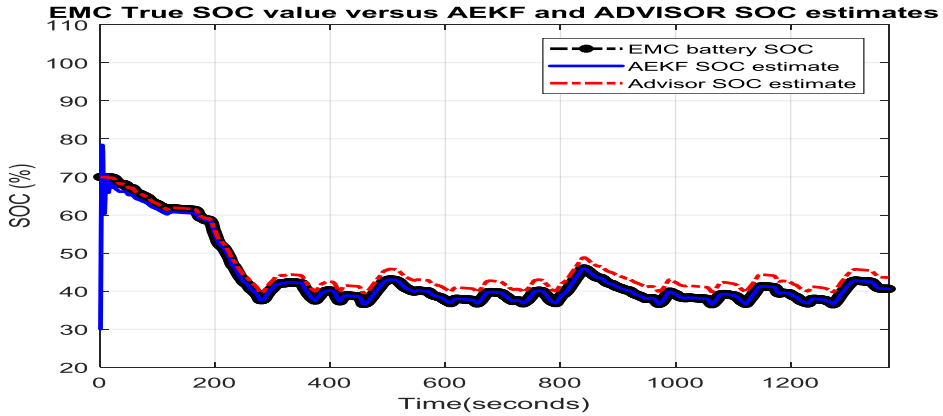

FIG.5. 3RC EMC Li-Ion battery SOC true value versus AEKF and ADVISOR SOC estimates @T=25°C

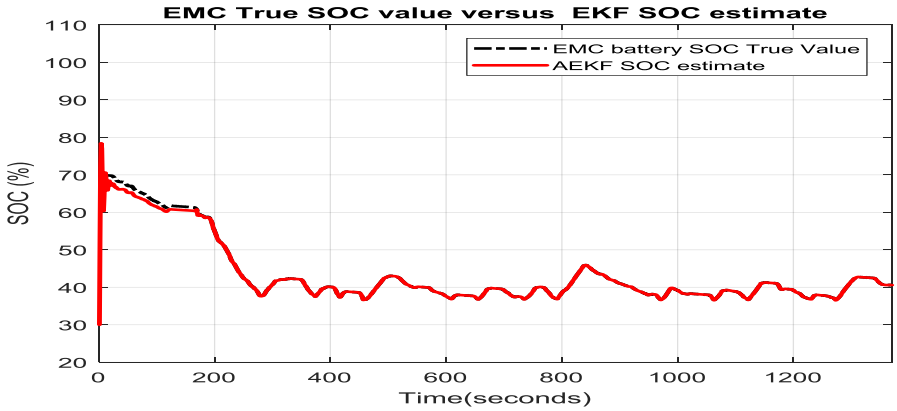

FIG.6. 3RC EMC Li-Ion battery SOC true value versus AEKF SOC estimate @T=25°C

The simulation results in **Fig.7** depicts a very good prediction of AEKF real time estimator of Li-Ion battery terminal voltage, and also a very good voltage estimation accuracy.

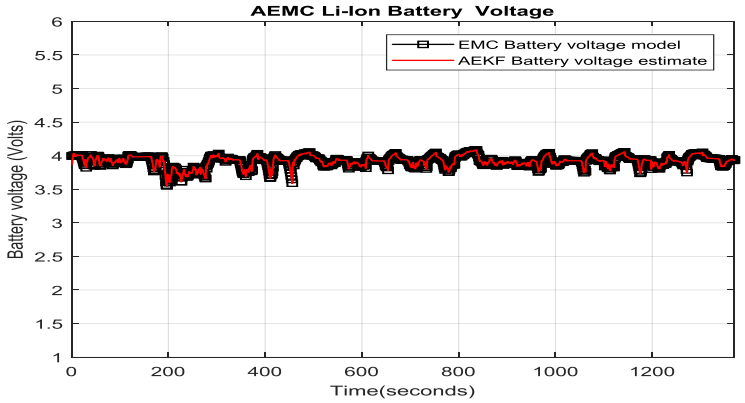

FIG.7. 3RC EMC Li-Ion battery voltage true value versus AEKF battery voltage estimate @T=25°C

The robustness of the AEKF SOC real time estimator to a change in initial Li-Ion battery SOC guess value from 70% to 30% is shown in all previous last three figures. Also, it is worth to remark its high convergence speed, such that the AEKF SOC estimate reaches the battery SOC true value with small oscillations after almost 100 seconds. The AEKF SOC estimator robustness to a decrease in nominal capacity of the battery by 50% due to aging and temperature effects is shown in **Fig.8** and **Fig. 9**. The simulation results reveal significant changes for Li-Ion battery SOC true and estimation values during entire UDDS discharging cycle current profile test and prediction time for battery terminal voltage, but the estimation accuracy and convergence speed still remain unaffected compared to the normal Li-Ion battery operating conditions.

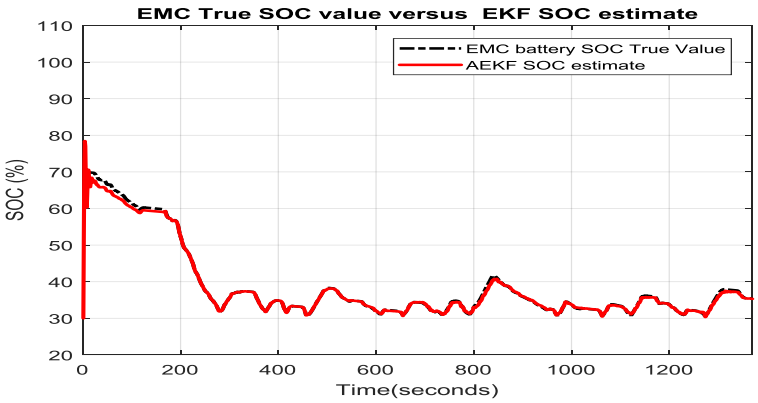

FIG.8. The robustness test of AEKF SOC estimator to a decrease by 10% of Li-Ion battery nominal capacity due to aging and temperature effects @T=25°C

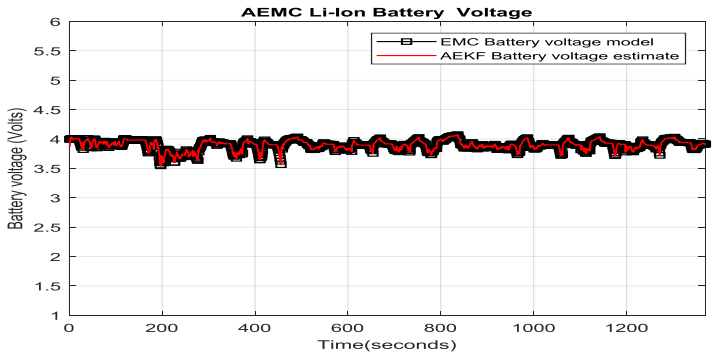

FIG.9. The robustness test of AEKF battery voltage to a decrease by 10% of Li-Ion battery nominal capacity due to aging and temperature effects @T=25°C

In **Fig. 10** and **Fig.11** is shown the robustness of AEKF SOC and battery voltage estimator to an increase of four times of internal resistance of the battery due to temperature effects. We remark that AEKF is very accurate, it has a high convergence speed, and is very robust to these changes.

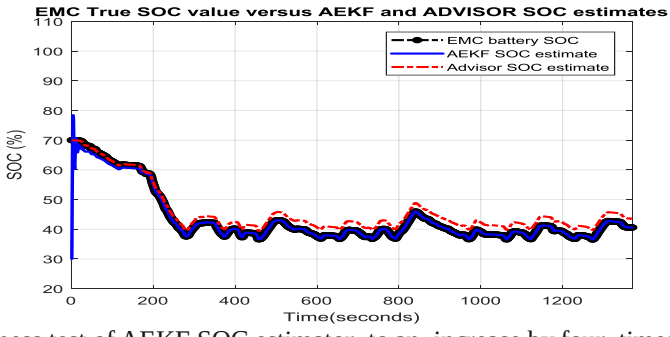

FIG.10. The robustness test of AEKF SOC estimator to an increase by four times of internal Li-Ion battery due to temperature effects @T=25°C

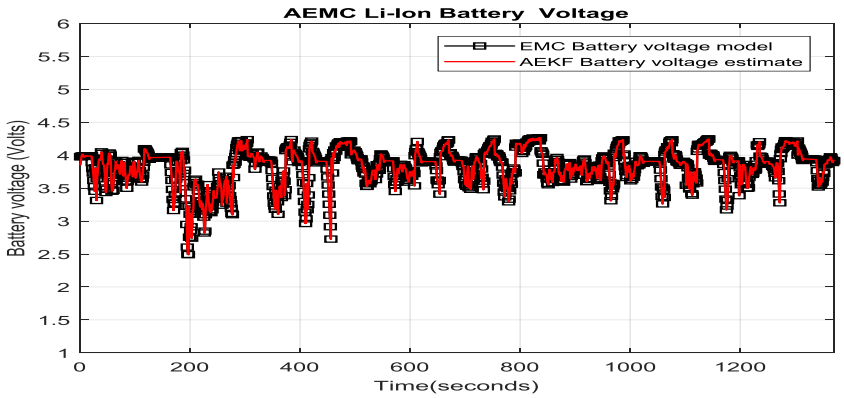

FIG.11. The robustness test of AEKF battery voltage estimator to an increase by four times of internal Li-Ion battery due to temperature effects @T=25°C

The robustness of AEKF SOC estimator to the temperature effects can be tested on the collection of fourth 3emc li-ion battery models corresponding to four different temperatures with the parameters given in table 1. the simulation results are shown in **Fig.12** until **Fig.19** that will be analyzed in terms of their performance in the next section.

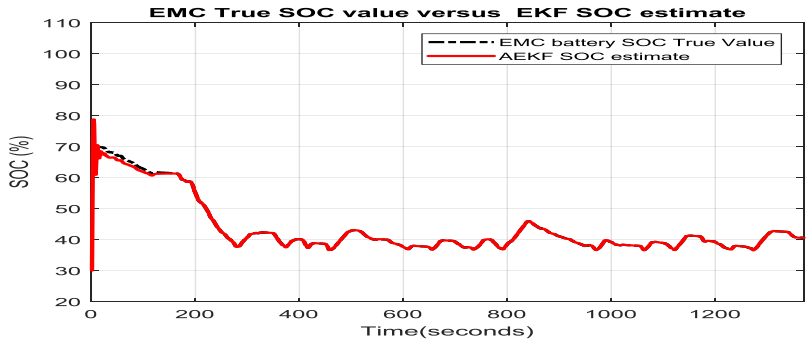

FIG.12 3RC EMC Li-Ion battery SOC true value versus AEKF SOC estimate @T=5°C

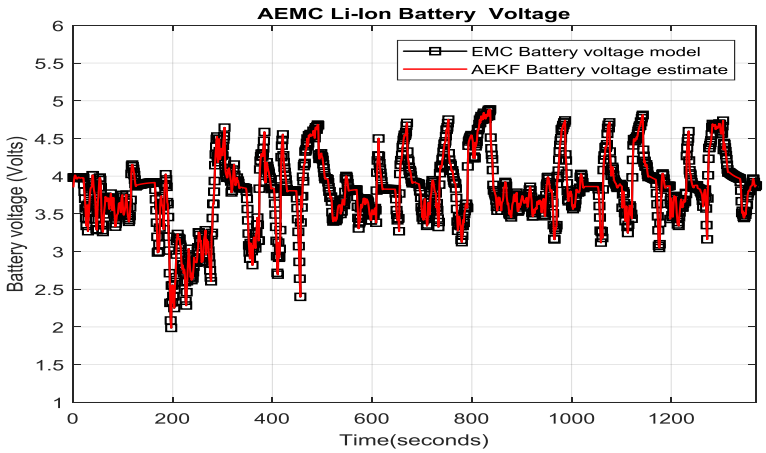

FIG.13. 3RC EMC Li-Ion battery voltage true value versus AEKF battery voltage estimate @T=5°C

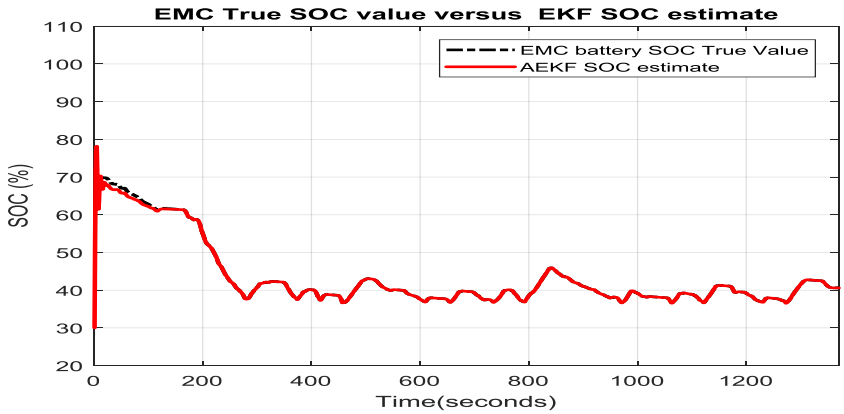

FIG.14. 3RC EMC Li-Ion battery SOC true value versus AEKF SOC estimate @T=15°C

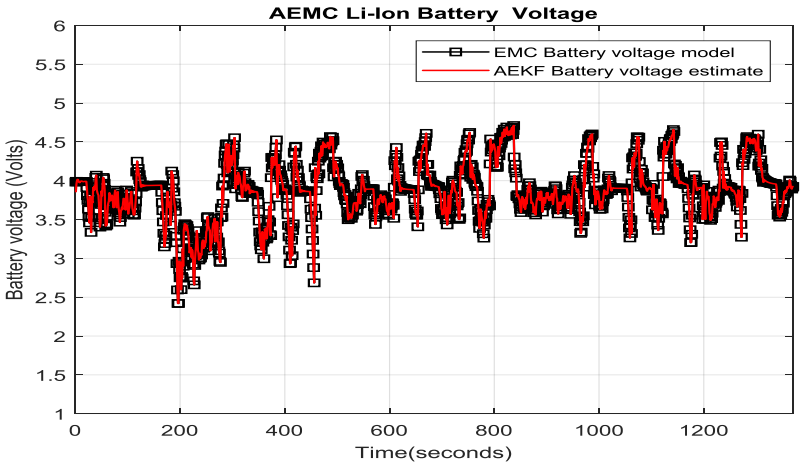

FIG.15. 3RC EMC Li-Ion battery voltage true value versus AEKF battery voltage estimate @T=15°C

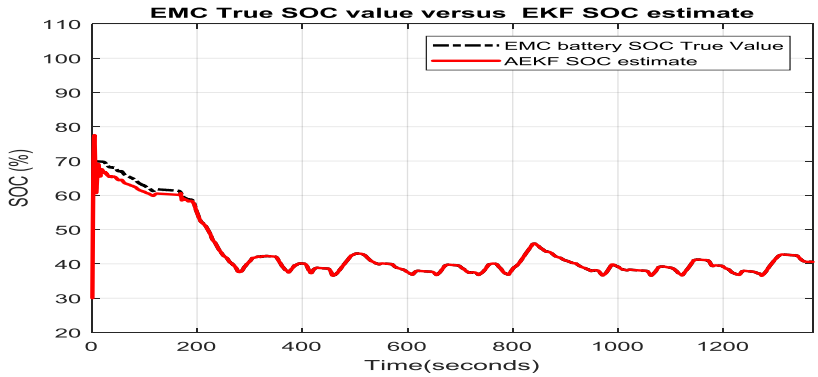

FIG.16. 3RC EMC Li-Ion battery SOC true value versus AEKF SOC estimate @T=20°C

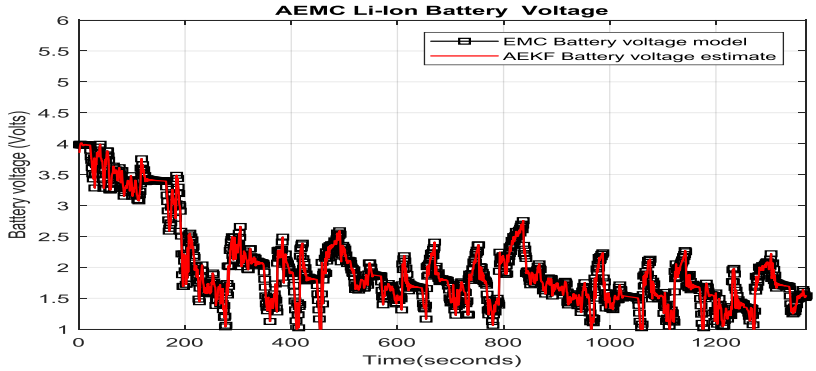

FIG.17. 3RC EMC Li-Ion battery voltage true value versus AEKF battery voltage estimate @T=20°C

Even if significant changes in SOC estimation values and terminal battery voltage prediction values take place, from simulation results still we can see the high SOC estimation accuracy and a very good terminal voltage prediction.

5.2 Real time implementation of the nonlinear observer SOC estimator in MATLAB R2017a simulation environment

The simulation results of Li-Ion battery SOC NOE estimation and battery terminal voltage NOE prediction @T=25°C are shown in **Fig. 18** to **Fig.21**. They reveal a good convergence speed, a very good SOC estimation accuracy, and a good robustness to changes in SOC initial guess, from 70% to 30%, and to a small decrease by 10% of the battery nominal capacity due to aging and temperature effects compared to 10% for AEKF SOC estimator. The robustness of NOE SOC estimator to the temperature effects can be tested in a similar way on the collection of three 3EMC Li-Ion battery models corresponding to three different temperatures with the parameters given in Table 1. The simulation results are shown in **Fig.22** until **Fig.27** that will be analyzed in terms of their performance in the next section.

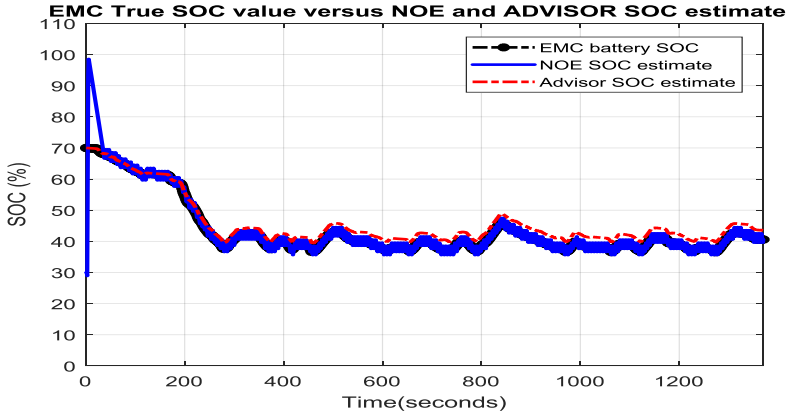

FIG.18. 3RC EMC Li-Ion battery SOC true value versus NOE and ADVISOR SOC estimates @T=25°C

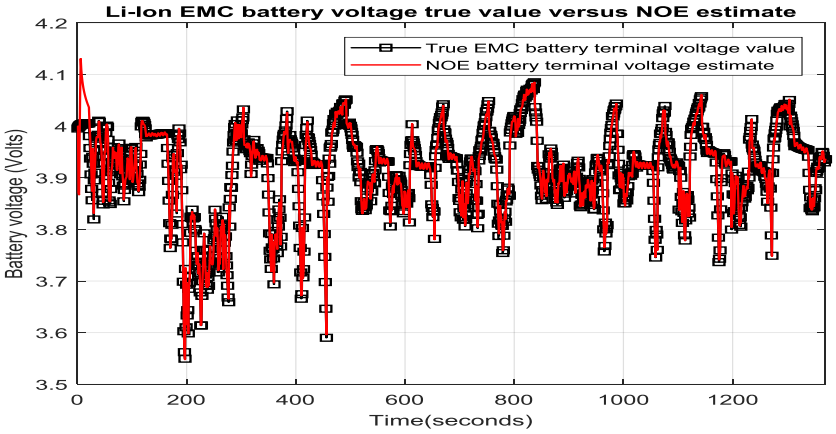

FIG.19. 3RC EMC Li-Ion battery voltage true value versus NOE battery voltage estimate @T=25°C

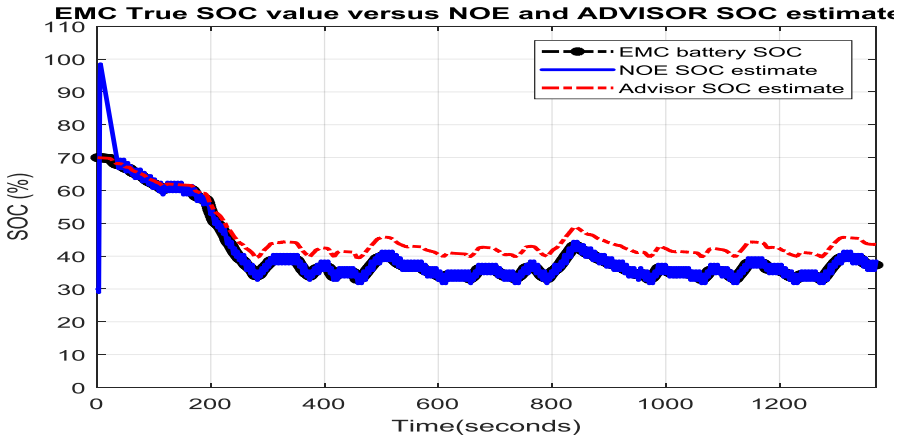

FIG.20. The robustness test of NOE SOC estimator to a decrease by 10% of Li-Ion battery nominal capacity due to aging and temperature effects @T=25°C

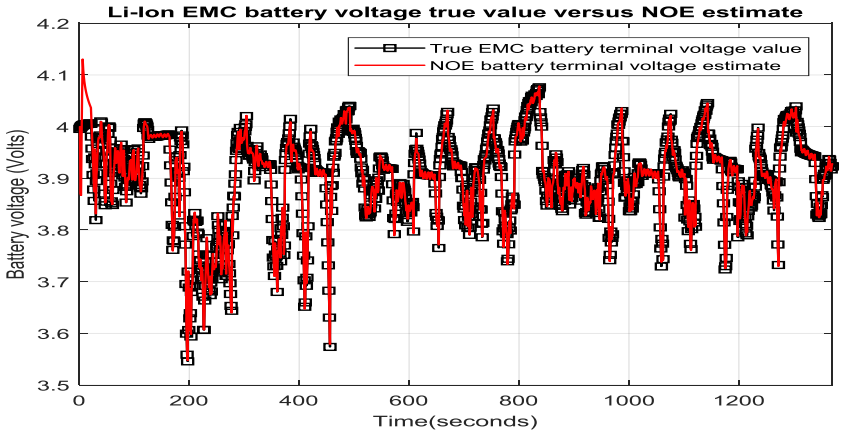

FIG.21. The robustness test of NOE battery voltage estimation to a decrease by 10% of Li-Ion battery nominal capacity due to aging and temperature effects @T=25°C

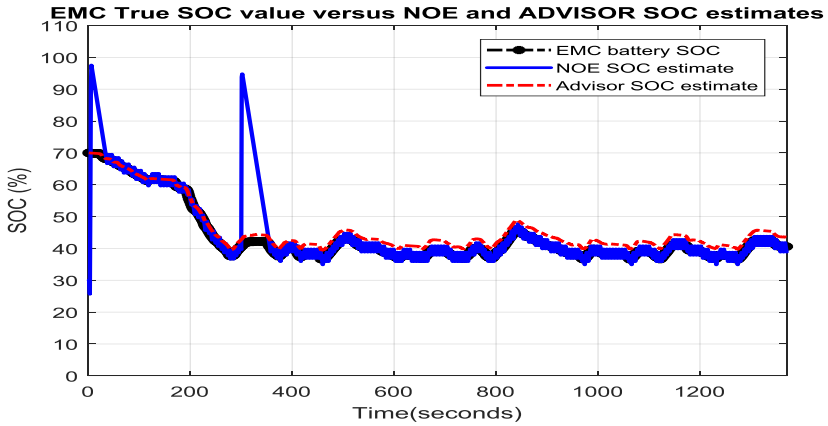

FIG.22. 3RC EMC Li-Ion battery SOC true value versus NOE SOC estimate @T=5°C

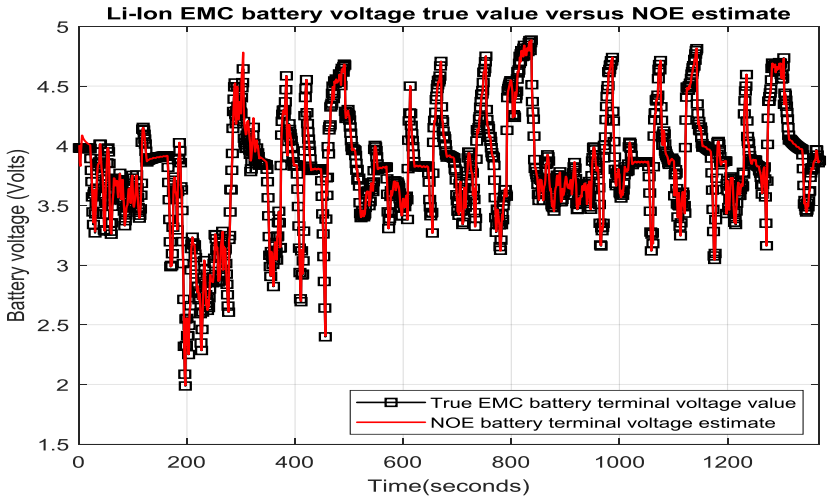

FIG.23. 3RC EMC Li-Ion battery voltage true value versus NOE battery voltage estimate @T=5°C

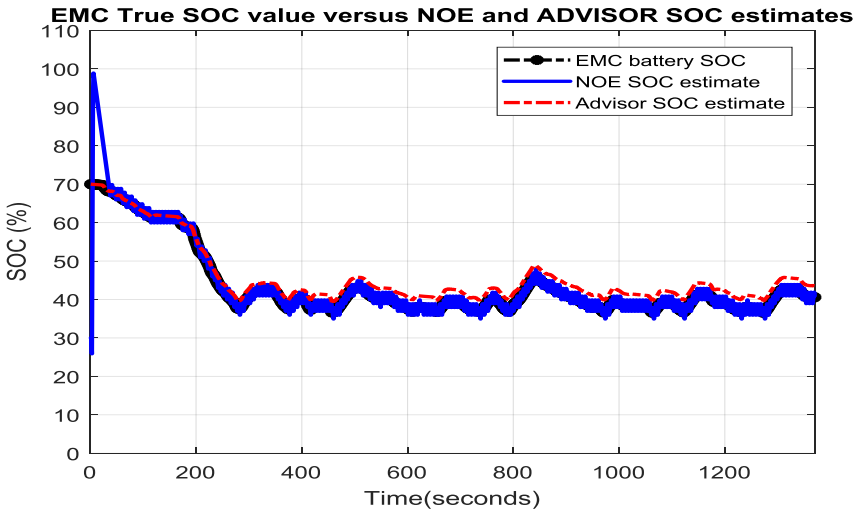

FIG.24. 3RC EMC Li-Ion battery SOC true value versus NOE SOC estimate @T=15°C

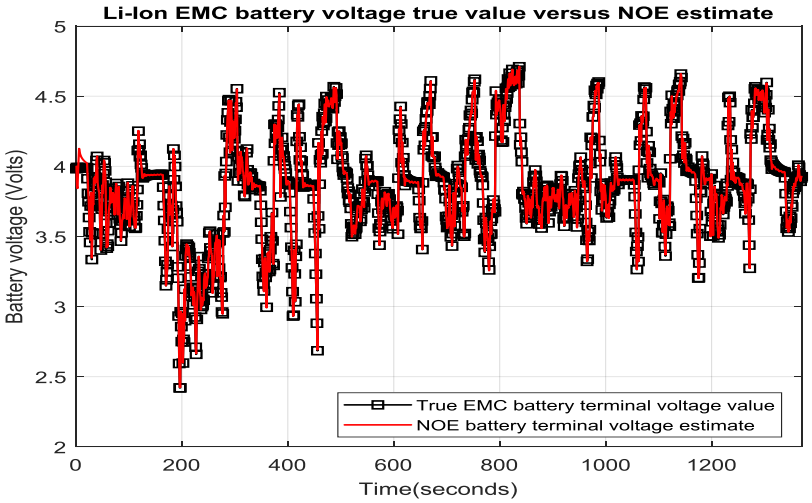

FIG.25. 3RC EMC Li-Ion battery voltage true value versus AEKF battery voltage estimate @T=15°C

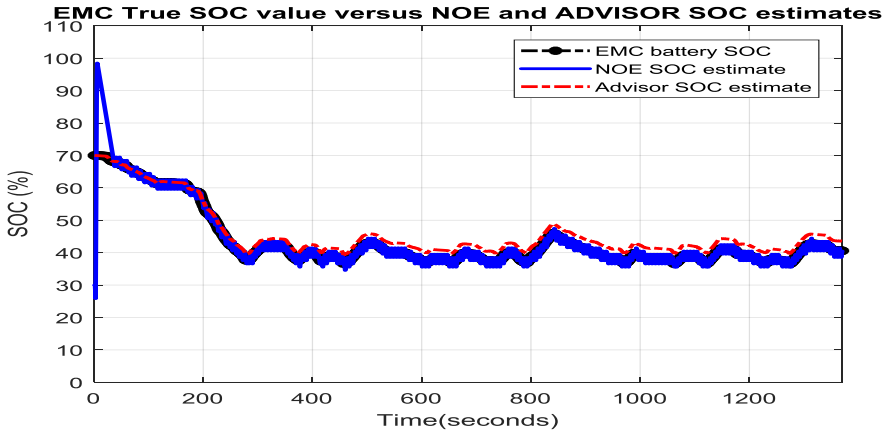

FIG.26. 3RC EMC Li-Ion battery SOC true value versus NOE SOC estimate @T=20°C

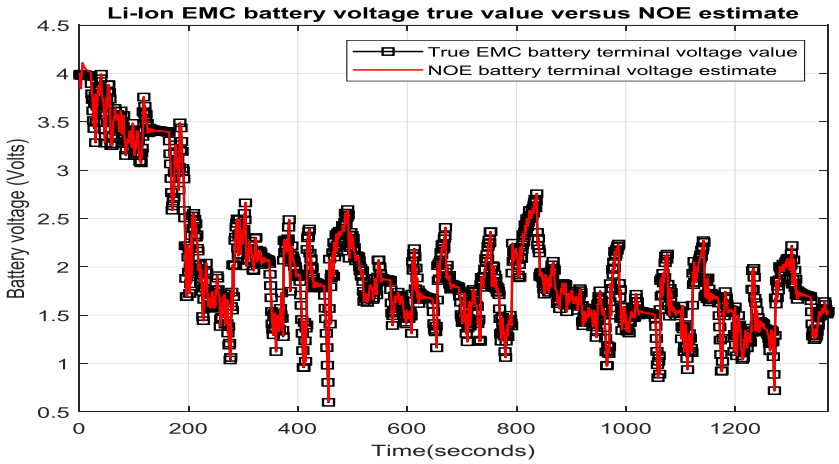

FIG.27. 3RC EMC Li-Ion battery voltage true value versus NOE battery voltage estimate @T=20°C

In **Fig. 28** and **Fig.29** is shown the robustness of NOE SOC and battery voltage to an increase four times of internal battery resistance. The simulations results reveal that for NOE SOC estimation considerable jitter effects occur compared to AEKF estimator.

All the simulations take place in a real time MATLAB R2017a simulation environment, for a complete UDDS discharging driving cycle current profile test of 1370 seconds length shown in **Fig.30.**

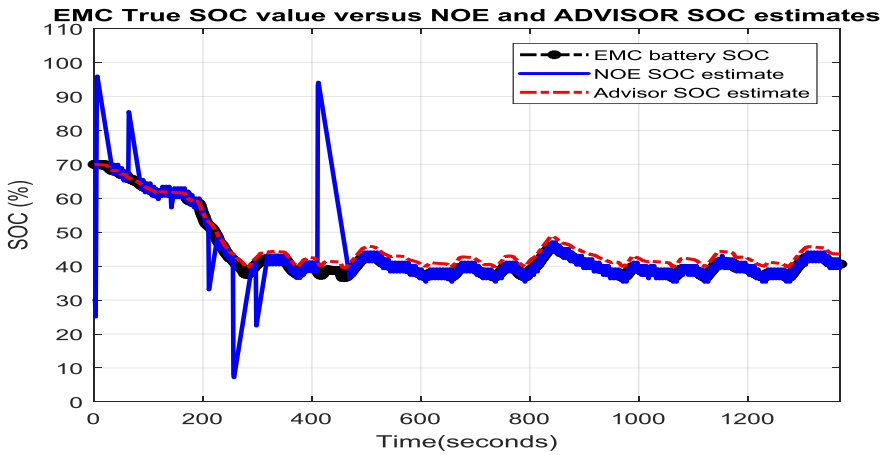

FIG.28. The robustness test of NOE SOC estimator to an increase by four times of internal Li-Ion battery due to temperature effects @T=25°C

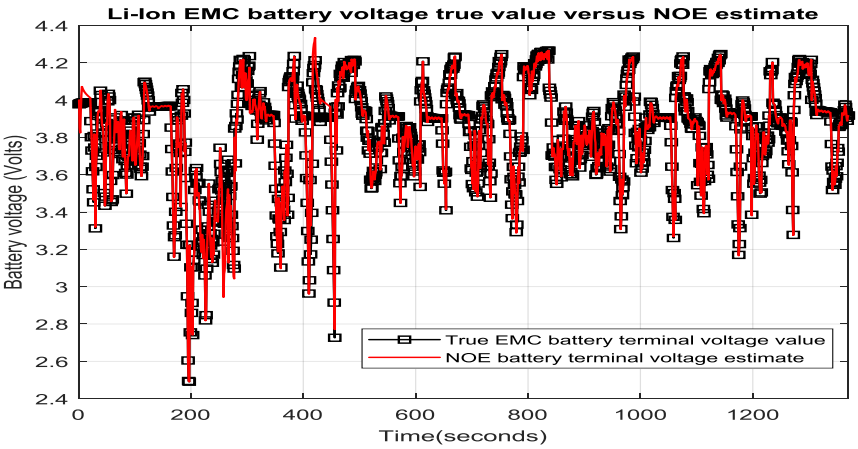

FIG.29. The robustness test of NOE battery voltage estimator to an increase by four times of internal Li-Ion battery due to temperature effects @T=25°C

We remark that NOE SOC and battery voltage estimator is very accurate, it has a high convergence speed, and is very robust to these changes.

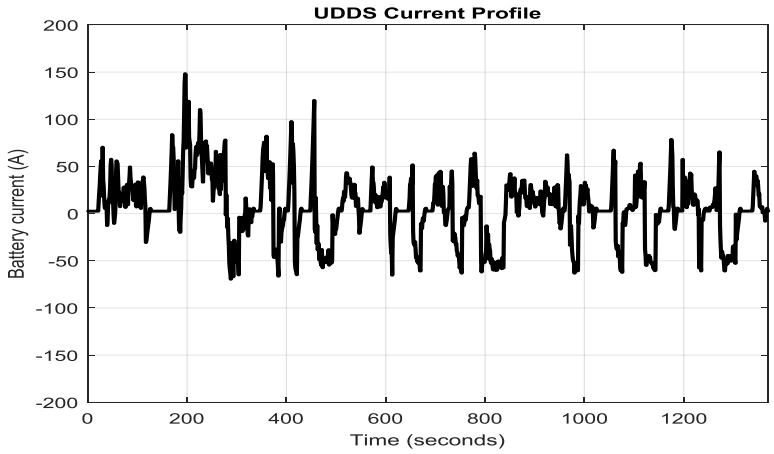

FIG.30. The discharging UDDS driving cycle current profile test .

5.3 Simulation results comparison - performance analysis

The MATLAB simulation results reveal the superiority of the 3RC EMC Li-Ion battery AEKF SOC estimator compared to 3RC EMC Li-Ion Battery NOE SOC estimator developed in section 5.1, and section 5.2 respectively. The AEKF SOC estimator converge much faster, is robust to all model parameters affected by the SOC and temperature, and is very accurately related to SOC estimation. Unlike AEKF SOC estimator, NOE SOC estimator introduces jitter effects in several situations when the temperature changes from 25°C to 5°C, and the internal resistance of the battery increases four times. Moreover, by comparing the SOCs true values with their AEKF and ADVISOR estimates we validate definitely all these four 3RC EMC Li-Ion battery models. Thus, the most suitable SOC estimator for this kind of HEAVs applications is AEKF real time estimator, more accurate, robust and easy to be built and implemented in real time in MATLAB R2017a simulation environment.

CONCLUSIONS

In this research paper is proposed a third order 3RC EMC Li-Ion battery model, one of the most suitable models from literature of high simplicity and accuracy, easy to be implemented in real time and to provide a beneficial support to build two real-time SOC estimators, namely an AEKF SOC and a NOE SOC estimators. To have a good insight of the realistic battery life environment the proposed 3RC EMC Li-Ion battery model under consideration investigates also the case when the battery parameters are time varying and dependent on temperature and SOC. This is an improved battery model useful to prove the robustness of the proposed SOC estimators to the model parameters changes for a particular collection of three Li-Ion batteries models extracted at the different temperatures, as is shown in Table 1. The robustness is also investigated for changes (increase or decrease) in SOC initial values, simultaneous changes in SOC initial values and changes in internal resistance of Li-Ion battery due to the effects mentioned in section 2.1, especially the temperature effects, and simultaneous changes in SOC initial value and a decrease in the nominal value of the battery capacity due to aging and temperature effects. By a rigorous performance analysis of MATLAB and SIMULINK simulation results for both proposed real time SOC estimators in terms of convergence speed, robustness, SOC estimation accuracy, battery terminal voltage prediction and real-time implementation simplicity, in our opinion the AEKF SOC estimator is the most suitable real-time estimator for this kind of HEVs applications compared to NOE SOC estimator. Many other topics remain still open for future investigations, such accurate online SOC estimation that needs reliable cell current measurement. In the future work adaptive and fuzzy logic SOC estimation strategies for Li-Ion batteries will be investigated and the battery models will be further improved by integrating the effect of degradation, temperature and SOC effects, as is mentioned also in [10].

Nomenclature

HEAV	hybrid electric aircraft vehicle
UAV	unmanned air vehicle
Li-Ion	lithium-ion
EV	electric vehicle
HEV	hybrid electric vehicle
BMS	battery management system
EMC	equivalent model circuit
ADVISOR	advanced vehicle simulator
EPA	environmental protection agency
UDDS	urban dynamometer driving schedule
OCV	open-circuit voltage
AEKF	adaptive extended Kaltman filter
NOE	nonlinear observer estimator
SOC	state of charge
DOD	depth of discharge
NREL	National Renewable Energy Laboratory

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ON-BOARD UAV VIDEO PROCESSING FOR GROUND TARGET TRACKING

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Abstract: *This paper presents a target tracking system based on video processing on the UAV. The primary role of the system is to overlay the center of the target selected by the ground operator with the center of the image displayed on the GCS (Ground Control Station) monitor. In fact, the coordinates of the two-dimensional object are initially determined in a Cartesian system, and later on, based on these coordinates are determined angular deviations in azimuth and elevation. Once the angular deviations have been obtained, the transmission to the gimbal controller on which the optical sensor is mounted will be done in digital format. This makes the target always be at the center of the image, which makes the image operator work significantly easier.*

Keywords: *target tracking, video processing, on-board, UAV, software.*

1. INTRODUCTION

As we know from the definition, target tracking is the prediction of the future location of a dynamical system based on its estimates and measurements.

Object detection and target tracking are two important domains of computer vision that if connected to artificial intelligence (AI) can make robotic systems more accurate and useful to humans. Also, a challenging problem is the strong weight and area constraint of embedded hardware that limits the drones to run computation intensive algorithms, such as deep learning, with limited hardware resource.

There is a wide range of applications when it comes to tracking the various objects of interest, hence the motivation of researchers worldwide to focus their attention on this area. Video surveillance is one of the most important. Surveillance systems not only record visual information but also extract data on motion, and more recently analyze suspicious changes within the frame. With these surveillance systems can be visually monitored other planes, vehicles, animals, micro-organisms or other moving objects but detecting and tracking people is of great interest. For example, human counting applications can provide important information about public transport, traffic congestion, trade and security.

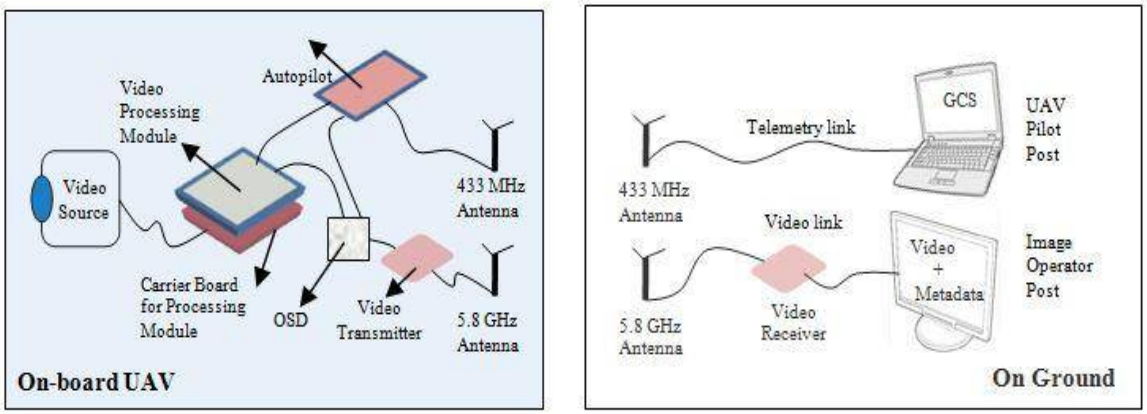
2. SYSTEM DESCRIPTION

In order to massively deploy drones and further reduce their costs, it is necessary to power drones with smart computer vision and autopilot. This increases the accuracy of detecting and tracking the target and the ability to accomplish specific missions.

The objective of video tracking is to associate target objects in consecutive video frames.

The association can be especially difficult when the objects are moving fast relative to the frame rate. Another situation that increases the complexity of the problem is when the tracked object changes orientation over time. For these situations video tracking systems usually employ a motion model which describes how the image of the target might change for different possible motions of the object.

The diagram of the target tracking system that was designed is shown in Fig. 1. It can be seen from the diagram that the UAV's main component and the brain of the system is Nvidia Jetson TX2 video signal processing module. Jetson TX2 is very fast and most power efficient (7.5 W) if you take into account its dimensions. It has 8 Gb of memory and almost 60 Gb/s of memory bandwidth. Also, it features a variety of standard hardware interfaces that make it easy to integrate with a wide range of carrier boards.



a. On-board UAV system hardware b. On Ground UAV system hardware

FIG.1 Target tracking system diagram

The tracking target system uses two data links: the telemetry channel that is set to the 433 Mhz frequency and provides command and control of both the autopilot and the optical sensor and the video channel that is set to the 5.8 Ghz and provides download link to the video receiver to be displayed on the image operator post monitor.

3. SOFTWARE ARCHITECTURE

Tracking algorithms can be classified into two major groups, namely state-space approach and kernel based approach. State-space approaches are based largely on probability, stochastic processes and estimation theory, which, when combined with systems theory and combinatorial optimization, lead to a plethora of approaches, such as Kalman filter, Extended Kalman Filter (EKF) [1], Unscented Kalman Filter (UKF) [2], Particle Filter (PF) [3]. The ability to recover from lost tracks makes state-space approach one of the most used tracking algorithms. However, some of them require high computational costs so they are not appropriate for real time video surveillance systems.

The Mean Shift (MS) algorithm is a non-parametric method which belongs to the second group. MS is an iterative kernel-based deterministic procedure which converges to a local maximum of the measurement function under certain assumptions about the kernel behaviors [4]. CamShift (Continuously Adaptive Mean Shift) algorithm [5] is based on an adaptation of mean shift that, given a probability density image, finds the mean (mode) of the distribution by iterating in the direction of maximum increase in probability density. CamShift algorithm has recently gained significant attention as an efficient and robust method for visual tracking. A number of attempts have been made to achieve robust, high-performance target tracking.

The Camshift principle is described as follows. The first step is to convert the image into color probability distributions, depending on the object's color histogram. The second step is the initialization of the dimension and the position of the search window. The last step is the adjustment with the result obtained in the previous step. After completing the 3 steps, we can locate the center of the object in the current image.

Firstly, we calculate the color histogram of the object. The RGB color space has weakness in representing shading effects or rapid illumination changing. To solve this problem, the Camshift algorithm adopts the HSV [6] (Hue Saturation Value) color space to describe the object. For each frame, the chrominance histogram is calculated as the following: Suppose that the number of total pixels in the frame is **n** , the chrominance grade of the histogram is **m** , and the chrominance grade index corresponding to the i-th pixel x_i is $c(x_i)_{i=1,\ldots,n}$,then the element of histogram $\{q_u\}_{u=1,\ldots,m}$ of this frame is

$$q_u = \sum_{i=1}^{n} \delta\left[c(x_i) - u\right], u = 1, 2, \ldots, m \tag{1}$$

where δ is unit impulse function. The formula of histogram normalization is as following:

$$\left\{ p_u = \min\left(\frac{255}{\max(q)} q_u, 255 \right) \right\}_{u=1,\ldots,m} \tag{2}$$

We can normalize the value range of the histogram corresponding to every chrominance grade to the interval of [0, 255] so that through back projection the value of each pixel in the image is related to the corresponding to the value of each chrominance grade in the histogram. Thus the probability distribution graph of object-color is obtained.

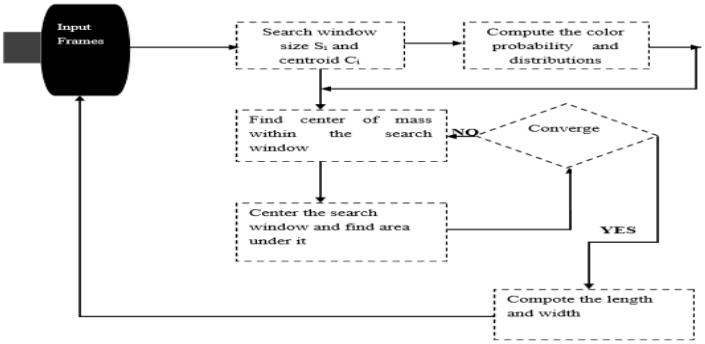


FIG.2 Traditional CamShift Algorithm

4. RESULTS

When the video signal is transmitted to the ground, the operator selects the target of interest with four points. The next step is to frame the target in a red rectangle and to determine the coordinates of the center, so that the video camera ghimbal then makes the corrections necessary to overlay the center of the image and the center of target.

a) Selecting a frame

b) Selecting the target

C) Positioning the target at the center of the image

5. CONCLUSION

The algorithm has been tested under various conditions and the results are satisfactory. The target is detected and tracked without interruption, and the algorithm used is not influenced by the speed of the target.

6. FUTURE WORK

As future work we intend to improve performance and reduce costs by combining video tracking and image stabilization in a single device. Therefore, we intend to design a compact gimbal which is capable to detect and track multiple targets in the same time with a lower power consumption video stream processor. Also, artificial intelligence has developed quite a lot lately and it is increasingly such that on the future gimbal we will try to implement machine learning or deep learning algorithms that will greatly help both the pilot and the image operator to accomplish their critical missions.

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ACCURATE LINEAR QUADRATIC OPTIMIZATION IN AVIATION AND SPACE APPLICATIONS

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Abstract: *Linear quadratic Gaussian (LQG) optimization is often used in aviation and space applications. Over three dozens of examples for such applications from the COMPleib benchmark collection are used in this paper to investigate the performance of a new Newton-type algorithm to solve LQG problems. The algorithm efficiency and its accuracy, measured in terms of normalized and relative residuals of computed solutions of algebraic Riccati equations (AREs), are analyzed. Various stabilizing initializations, including that provided by the state-of-the-art MATLAB solver, are considered. The numerical results strongly recommend this algorithm especially for improving approximate solutions computed using other approaches.*

Keywords: *algebraic Riccati equations, linear quadratic optimization, numerical algorithms, optimal control*

1. INTRODUCTION

Algebraic Riccati equations (AREs) are cornerstones for control theory and its practical applications. Many control systems analysis and design procedures require their solution. AREs are the main topic of Linear Quadratic Gaussian (LQG) optimization, involved in optimal control and estimation problems. Such equations appear in various domains, including model reduction, optimal filtering, guidance, (robust) control, etc. Many applications are encountered in the aerospace domain. Actually, control theory recorded a strong development during and after the second World War, mainly to support such applications.

In general, optimization needs powerful computational tools and simulation techniques. Of major importance for numerical calculations are reliability, efficiency, and accuracy of the results. This is due to several reasons, including the limited precision of the calculations, and the need for having the results as quickly as possible (especially, for real-time applications). Moreover, the hidden nature of the intermediate results, from which the returned solution is obtained, requires guarantees on their correctness.

There are several formulas for AREs, depending on the system involved. Of interest in this paper is the continuous-time ARE (CARE) for standard systems, defined by

$$R(X) := A^T X + XA - XBR^{-1}B^T X + Q = 0, \tag{1}$$

where X is the unknown matrix, A and Q are $n \times n$, B is $n \times m$, R is $m \times m$, with Q, R, and X symmetric matrices ($Q = Q^T$, $R = R^T$, $X = X^T$), Q positive-semidefinite ($Q \geq 0$), R positive definite ($R > 0$), hence R nonsingular. The matrices A and B are the state and input (control) matrices of the dynamic system $dx/dt = Ax(t) + Bu(t)$, $x(0) = x_0$, while Q and R are the state and input weighting matrices of the performance index, which should be minimized along the system trajectories. With suitable assumptions, such as, the pair (A, B) is stabilizable, and (A, D) detectable, where D is a maximal rank factor of Q, i.e., $D^T D = Q$ and rank(D) = rank(Q), then (1) has a unique positive-semidefinite stabilizing solution, $X^* = X^{*T} \geq 0$, and the optimal control trajectory is given by the state feedback law $u^*(t) = -R^{-1}B^T X^* x(t)$ [1]. This law ensures the stability of controlled system. Specifically, the "closed-loop" system matrix, defined by $A - BR^{-1}B^T X^*$ is stable, that is, all its eigenvalues have negative real parts. Defining $K(X) = R^{-1}B^T X$, then $K(X^*)$ is the controller optimal gain matrix. By a suitable selection of the weighting matrices Q and R, the closed-loop dynamics can be modified to satisfy certain performance criteria, including fast transient response, trajectory following, disturbance rejection, etc.

Dual to the control problem is the estimation problem, which aims to find proper values of some parameters, or of the state of a dynamic system, using observers or filters, like Kalman filter. Many theoretical results have been extended to more general classes of systems, including periodic systems, nonlinear systems, discrete-event systems, etc.

The solutions of a CARE are the matrices $X = X^T$ for which $R(X) = 0$. When Y is not a solution of (1), then $R(Y)$ differs from the zero matrix; $R(Y)$ is called the *residual* of (1) in Y. The Frobenius norm of $R(Y)$, $||R(Y)||_F$, is a measure of the error in Y with respect to the solution X.

The literature regarding theory and numerical solution of AREs and their practical applications is vast. Several monographs, e.g., [1-5], address various theoretical and practical issues. There are many techniques and algorithms to compute the optimal solution X^* (see, e.g., [4,5]). Both direct or iterative algorithms have been proposed. The first class contains the (generalized) Schur techniques, e.g., [6-8]. The second class has several categories, including matrix sign function techniques, e.g., [9,10], Newton techniques [6,11], doubling algorithms [12,13], or recursive algorithms [14]. Often used is the direct procedure which computes a basis U of the stable invariant subspace of a Hamiltonian $2n \times 2n$ matrix H built using A, B, Q, and R^{-1}. If R is ill-conditioned with respect to inversion, then the obtained matrix H and, therefore, the computed solution X, will be inaccurate. Therefore, in such a case, it is preferable to use an extended matrix pencil of order $2n + m$ instead of H, and compute the associated stable right deflating subspace. This procedure, using either the matrix H, or the extended matrix pencil, is implemented in the state-of-the-art MATLAB function **care**. This matrix pencil can be rewritten as a structured, skew-Hamiltonian/Hamiltonian (sHH) pencil [15], and the optimal problem can be solved by structure-exploiting algorithms [16]. Software implementations for sHH pencils have also been included in the Subroutine Library for Control Theory (SLICOT) [17] (www.slicot.org). Applications in optimal and robust control have been described, e.g., in [18,19].

Newton's method for solving AREs has been considered by many authors, for instance, [3-6]. But matrix sign function method for AREs [9,10] is actually a specialization of Newton's method for computing the square root of the identity matrix of order $2n$.

Newton's method is best used for iterative improvement of a solution, or as a defect correction method [20], delivering the maximal possible accuracy when starting from a good approximate solution. Moreover, it may be preferred in implementing certain fault-tolerant systems, which require controller updating [21].

2. MODIFIED NEWTON ALGORITHM

The algorithmic variants considered in the sequel for CAREs are extensions of Newton's method, which employ a line search procedure attempting to reduce the residual along the Newton direction. The conceptual algorithm can be stated as follows [22]:

Algorithm NCARE: Modified Newton method for CARE

Input: The coefficient matrices A, B, Q, R, and an initial stabilizing matrix $X_0 = X_0^T$.

Output: The approximate solution X_k of CARE (1).

FOR $k = 0,1, \dots, k_{max}$, DO

1. Compute $R(X_k)$. If (non)convergence is detected, return X_k and/or a warning or an error value.
2. Compute $K_k := K(X_k)$ and A_k, where $A_k = A - BK_k$.
3. Solve in N_k the Lyapunov equation $A_k^T N_k + N_k A_k = -R(X_k)$.
4. Find a step size t_k which minimizes $||R(X_k + tN_k)||_F$ with respect to t.
5. Update $X_{k+1} = X_k + t_k N_k$.

END

Standard Newton algorithm is obtained by taking $t_k = 1$ in Step 4 at each iteration. When the initial matrix X_0 is far from a Riccati equation solution, Newton's method with line search often outperforms the standard Newton's method.

With usual assumptions (e.g., stabilizability of the system pair (A, B), and existence and uniqueness of the stabilizing solution X^*), if X_0 is stabilizing, then the iterates of the Algorithm NCARE with $t_k = 1$ have the following properties [22]:

(a) All matrices X_k are stabilizing.

(b) $X^* \leq \cdots \leq X_{k+1} \leq X_k \leq \cdots \leq X_1$.

(c) $\lim_{k\to\infty} X_k = X^*$.

(d) There is a constant $\gamma > 0$ such that $\|X_{k+1} - X^*\| \leq \gamma \|X_k - X^*\|^2$, $k \geq 1$.

Note that the global quadratic convergence at item (d) does not hold for $k = 0$, involving the iterates X_0 and X_1. The line search variant does not ensure the monotony of the sequence $\{X_k\}$ in terms of definiteness, as in (b), but the convergence of the residual sequence to the zero matrix. The other properties hold; in addition, $\lim_{k\to\infty} t_k = 1$.

More general algorithms for generalized or discrete-time systems, possibly including a state and input cross weighting matrix, are dealt with, e.g., in [22,23], and are implemented in a new Newton-type solver.

The basic stopping criterion for the iterative process of the Newton solver is expressed in terms of a *normalized residual*, $r_k := r(X_k) := \|R(X_k)\|_F / \max(1, \|X_k\|_F)$, and a tolerance τ. If $r_k \leq \tau$, the iterative process is successfully terminated. If $\tau \leq 0$, a default tolerance is used, defined in terms of the Frobenius norms of the given matrices, and relative machine precision, ε_M.

For systems with very large norms of the matrices A, B, and/or Q, and a small norm of the solution X^*, the stopping criterion involving r_k might not be satisfied in a reasonable number of iterations (or never, due to accumulated rounding errors), while an acceptable approximate solution might be much earlier available. Therefore, the MATLAB-style *relative residual*, $r_r(X_k)$, which is the ratio of $\|R(X_k)\|_F$ and the sum of Frobenius norms of the matrix terms of (1), is also tested at iterations $10 + 5q$, $q = 0,1, \ldots$, and it might produce the termination of the iterative process, instead of the criterion based on the normalized residual r_k. The relative residual is not tested at each iteration in order to reduce the computation costs, and to increase the chances of termination via the normalized residual test.

Often, but mainly in the first iterations, the computed optimal steps t_k are too small, and the residual decreases too slowly. This is called *stagnation*, and remedies are used to escape stagnation. Specifically, t_k is set to 1 when stagnation, or other criteria of slow convergence, are detected. This is equivalent with a restart of the standard Newton algorithm, which is theoretically guaranteed to converge from any stabilizing initialization. On the other hand, after such a reset, the residual norm might increase, sometimes significantly, but fewer unit steps are generally needed than for a stagnating line search procedure. Anyhow, the residual increase is smaller than what might appear in the beginning of the iterative process if only standard steps would be used. Consequently, this strategy is very attractive.

Other line search strategies, including *combined* or *hybrid strategies* have also been investigated. Specifically, in the combined strategy, line search is employed in the beginning of the iterative process, but the algorithm switches to the standard method when the normalized residual is smaller than a specified (or default) tolerance. In the hybrid strategy, both standard Newton step and the step corresponding to the line search procedure are computed, and the step which gives the smallest residual is selected at each iteration.

3. NUMERICAL RESULTS

This section presents some results of a performance investigation of the new Newton solver, developed by the author. The numerical results have been obtained on an Intel Core i7-3820QM portable computer at 2.7 GHz, with 16 GB RAM, with the relative machine precision $\varepsilon_M \approx 2.22 \times 10^{-16}$, using Windows 7 Professional (Service Pack 1) operating system (64 bit), Intel Visual Fortran Composer XE 2015 and MATLAB 8.6.0.267246 (R2015b). A MATLAB executable MEX-function has been built using MATLAB-provided optimized LAPACK [24] and BLAS subroutines.

The results reported here have been obtained for linear systems modelling aerospace applications from the COMPl$_e$ib collection [25], which contains 124 standard continuous-time models. Specifically, the examples tried are listed below, where the notation n = [a..b] means that n has a minimum value a and a maximum value b, and p is the number of system outputs:

- Aircraft models (AC1−AC18), with n = [4..55], m = [1..4], p = [2..4];
- Helicopter models (HE1 − HE7), with n = [4..20], m = [2..4], p = [1..6];
- Jet engine models (JE1 − JE3), with n = [21..30], m = 3, p = [3..6];
- Academic models (NN5, NN15, NN16), with n = [3..8], m = [1..4], p = [2..4];
- Flexible satellite model (FS), with n = 5, m = 1, p = 3;

- Space structure models (DLR1 − DLR3), with n = [10..40], $m = p = 2$;
- International Space Station component (ISS1, ISS2), with n = 270, $m = p =$ 3;
- Reduced order models (ROC2, ROC5), with n = [7..10], m = [2..3], p = [3..5].

A brief description is given below. More details are given in [25] and the references therein. AC1 and AC2 model the linearized vertical-plane dynamics of an aircraft. AC3 models an L-1011 aircraft in cruise flight conditions, while AC4 describes an autopilot control problem for an air-to-air missile. AC5 describes the motion of a Boeing B-747 aircraft flying at 20000 ft with a speed of Mach 0.8. AC6 is an L-1011 aircraft model; AC7 and AC8 model the motion of a transport aircraft at 35000 ft, with Mach 0.57 and with the center of gravity at the most aft location, and at the aft location, respectively. AC9 is a variation of AC8 with an additional state and four inputs instead of one. AC10 is an aeroelastic model of high order describing a modified Boeing B-767 airplane at flutter condition. AC11 is a linearized model of an CVC-type aircraft. AC12 − AC14 define the linearized equations of motion for the longitudinal dynamics of an ASTOVL (Advanced Short Take-Off and Vertical Landing) aircraft, with increasing orders. AC15 and AC16 model a supersonic transport aircraft flying at Mach 2.7. AC17 is a model of the lateral axis dynamic of a L-1011 aircraft, and AC18 is a reduced order model of AC10.

HE1 describes the longitudinal motion of a VTOL helicopter at flying speed of 135 knots, while HE2 models the longitudinal-vertical motion of an AH-64 helicopter at 130 knots. HE3 represents the linearized dynamics of a Bell 201A-1 helicopter, and HE4 − HE7 are variations of a model for a twin-engine, multi-purpose military helicopter.

JE1 represents a J-100 jet engine, and JE2 and JE3 are variations of a model for a Rolls-Royce 2-spool reheated turbofan for a military aircraft.

NN5 is a model of a Saturn V booster, while NN15 is a space backpack model, and NN16 describes a large space structure.

FS presents the dynamics of a flexible satellite, deduced from a second order model (with damping and stiffness matrices). DLR1−DLR3 are variations of a model describing the active vibration damping of large flexible space structures. ISS1 and ISS2 are models of a component of the International Space Station.

Finally, ROC2 models the same aircraft as AC7, but for an altitude of 25500 ft at Mach 0.87, and ROC5 describes a free gyro-stabilized mirror system used to stabilize the sensors mounted on vehicles subjected to vibrations, like aircrafts and helicopters.

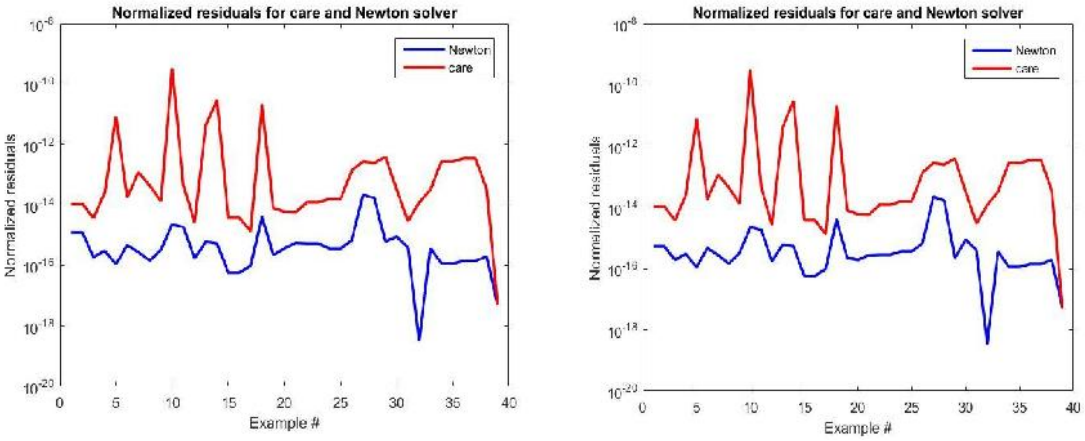
The algebraic Riccati equations have been solved for all these 39 examples, using weighting matrices set to identity, $Q = I_n$, $R = I_m$. The purpose of our study was not to find suitable weighting matrices for solving specific optimal control problems, but to investigate the performance of the new solver.

In one set of tests, Newton solver was initialized by the solution computed by the state-of-the-art MATLAB function **care**. The tolerance τ has been set either to the default value, or to ε_M. With the default value, Newton solver needed just one iteration to achieve the required accuracy for all examples, except ROC5 (numbered 39), for which it returned before finishing the first iteration, because $\|R(X_0)\|_F$ was already below the tolerance value. With tolerance ε_M, Newton solver needed 0 iterations for ROC5, 2 iterations for AC18, HE2 − HE5, and DLR1, 3 iterations for NN5, 4 iterations for AC1 and AC2, and still 1 iteration for the remaining 29 examples.

Figure 1 displays the normalized residuals of CARE solutions for the mentioned 39 examples from the COMPl$_e$ib collection, computed using MATLAB function **care** and standard Newton solver, with **care** initialization and either default tolerance, in part (a), or tolerance ε_M, in part (b). Slightly more accurate results than in part (a) are obtained in part (b) for examples mentioned above, numbered 1, 2, 18, 20:23, 29, and 33, which needed more than one iteration. For all examples, but the last one (ROC5, numbered 39), Newton solver was more accurate than **care**, and it improved the normalized residuals sometimes with several orders of magnitude. (Note that the ordinate axes are in a logarithmic scale.)

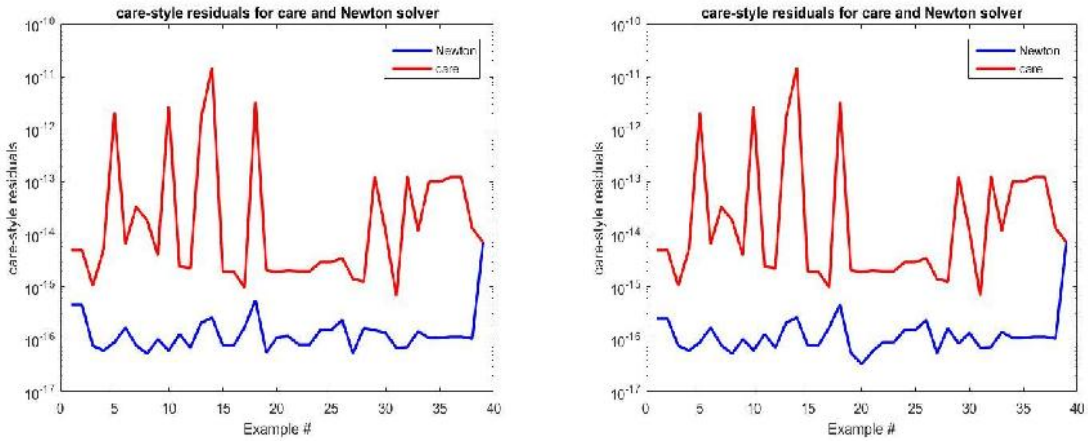
In the same way as in Fig. 1, Fig. 2 plots the MATLAB-style relative residuals. Using a tolerance set to ε_M, slightly more accurate results are obtained for the same examples as above. It is worth mentioning that Newton solver obtained relative residuals close to the limiting accuracy ε_M of the computer, or even smaller than ε_M, while **care** sometimes returned much larger residuals. Moreover, the variation of these values is in a much larger interval for **care** than for Newton solver, which shows a more uniform behavior. For most examples, this improvement is obtained in just one Newton iteration.

Similarly, Fig. 3 shows the corresponding elapsed CPU times for the two solvers. Part (a) of Fig. 3 compares **care** and standard Newton solver, while part (b) also includes modified Newton solver; moreover, balancing the matrices A_k was either used or not before solving Lyapunov equations for both variants. (Balancing may reduce the 1-norm of a matrix and improve accuracy of the computed results.) Clearly, balancing, but especially line search (LS), increases somewhat the computing time. Since the normalized and relative residuals for all these four options were the same with **care** initialization, it is recommended to use standard Newton variant (STD) in such a case. Since very few iterations are most often needed, the CPU time for Newton solver is a small fraction of that for **care**.



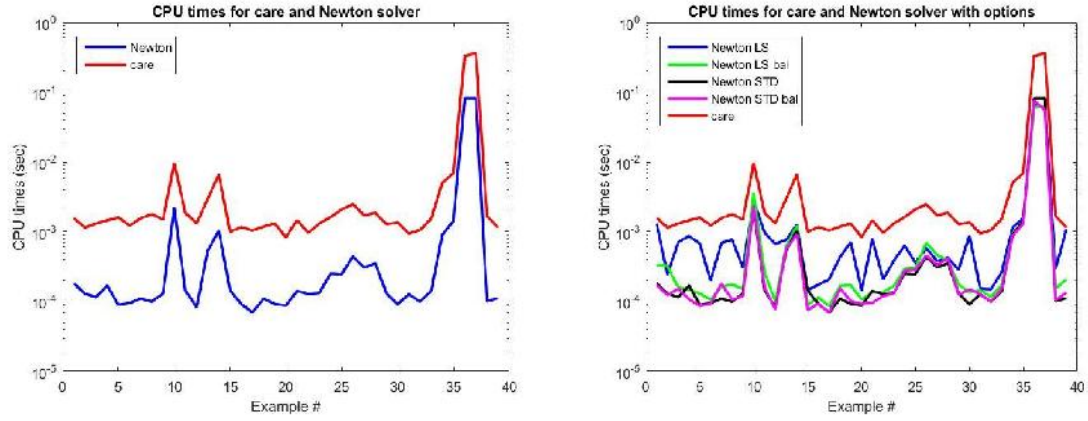
(a) (b)

FIG. 1. Normalized residuals for 39 COMPl$_e$ib examples using MATLAB function **care** and standard Newton solver with: (a) default tolerance; (b) tolerance;slightly more accurate results than in part (a) are obtained in part (b) for examples numbered 1, 2, 18, 20:23, 29, and 33



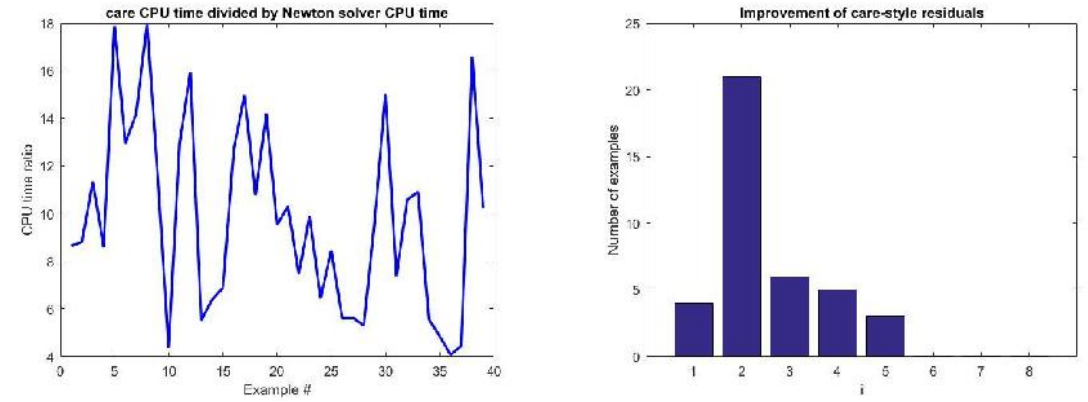
(a) (b)

FIG. 2. Relative, **care**-style residuals for 39 COMPl$_e$ib examples using MATLAB function **care** and standard Newton solver with: (a) default tolerance; (b) tolerance; slightly more accurate results than in part (a) are obtained in part (b) for examples numbered 1, 2, 18, 20:23, 29, and 33



(a) (b)

FIG. 3. Elapsed CPU times for solving 39 COMPl$_e$ib examples using MATLAB function **care** and Newton solver with default tolerance; (a) CPU times for **care** and standard Newton solver; (b) CPU times for **care** and Newton solver with various options: line search (LS); LS with balancing (LS bal); standard (STD); STD with balancing (STD bal); option STD is usually the fastest



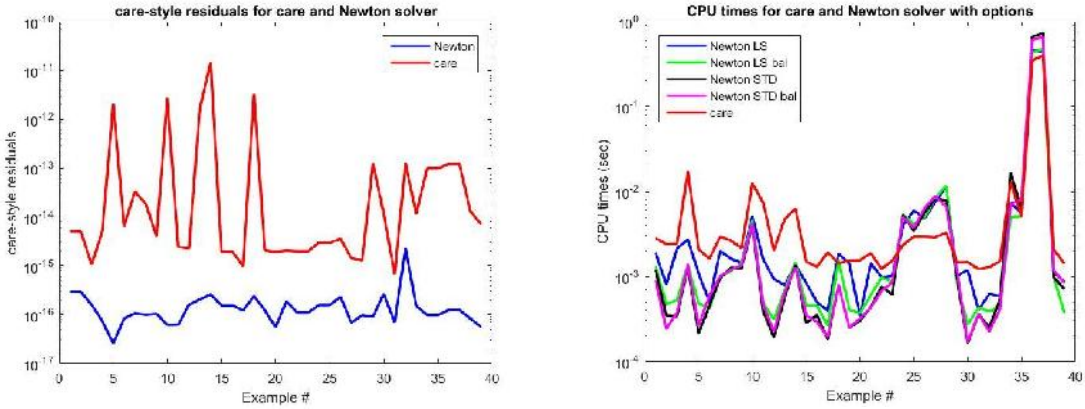
(a) (b)

FIG. 4. (a) Ratios of the elapsed CPU times for MATLAB function **care** and standard Newton solver with default tolerance; (b) improvement of **care**-style residuals obtained by standard Newton solver against **care** solver; the height of the i-th bar indicates the number of examples for which the improvement was between i-1 and i orders of magnitude

Part (a) of Fig. 4 plots the ratios of the elapsed CPU time needed by MATLAB function **care** and standard Newton solver. The bar graph from part (b) shows the improvement obtained using standard Newton solver, default tolerance and **care** initialization. Specifically, the height of the i-th vertical bar indicates the number of examples for which the improvement was between i−1 and i orders of magnitude, in comparison to **care**. The number of examples in the five bins are 4, 21, 6, 5, and 3, corresponding to improvements till one order of magnitude for four examples, between one and two orders of magnitude for 21 examples, and so on, and finally between four and five orders of magnitude for 3 examples.

In another set of tests, X_0 was set to a zero matrix, if A was found to be stable; otherwise, an initialization of Newton solver with a matrix computed using the stabilization algorithm in [11] was tried, and when this algorithm failed to deliver a stabilizing X_0 matrix, the solution provided by **care** was used. There are 12 stable examples (AC3, AC6, AC15 −AC17, HE2, JE1, DLR1−DLR3, ISS1, and ISS2), but the other 27 examples are unstable. For 11 examples and default tolerance, one or another variant of Newton's method obtained larger normalized and **care**-style residuals than MATLAB function **care**. These examples are AC3, AC6, JE1 − JE3, DLR1 − DLR3, ISS1, ISS2, and ROC5, and eight of them are stable. But either standard Newton variant (for AC3, AC6, and JE1), or Newton variant with line search (for other examples, but ROC5), was more accurate by one or more orders of magnitude.

Figure 5 (a) plots the MATLAB-style relative residuals for **care** and standard Newton solver with tolerance set to ε_M. Figure 5 (b) shows the elapsed CPU times for **care** and both standard and modified Newton solver with tolerance ε_M, with or without balancing. Standard and modified Newton solvers are more accurate for all examples, but they can be more time consuming than **care** for some examples, which require more iterations with X_0 set to 0, or to the matrix computed by the algorithm in [11]. This happened for examples HE6, HE7, JE1 − JE3, DLR3, ISS1, and ISS2.



(a) (b)

FIG. 5. Relative residuals and elapsed CPU times for solving 39 COMPl$_e$ib examples using MATLAB function **care** and Newton solver with tolerance ε_M and various initializations (either **0**, or provided by the algorithm in [11], or by **care**); (a) relative residuals for **care** and standard Newton solver; (b) CPU times for **care** and Newton solver with various options: line search (LS); LS with balancing (LS bal); standard (STD); STD with balancing (STD bal); for few examples, **care** is the fastest solver

The maximum number of iterations was 29 for JE2 and JE3 with line search variant and for ROC5 with standard variant. Specifically, for ROC5, with unit step sizes, the solver generated an iterate X_1 with a residual of Frobenius norm larger than 10^{14} and needed 26 iterations to reduce it to a value less than 1, and finally to about 10^{-11} (with a corresponding normalized residual of order 10^{-15}). On the other hand, line search variant started with a step size of order 10^{-8} and returned after five iterations with a step size very close to 1, and a residual value of order 10^{-8} (with a corresponding normalized residual of order 10^{-12}). This shows the potential of line search to speed up the convergence rate. A similar behavior was encountered for several other examples.

The mean number of iterations was almost 11 for the line search variant and 14 for the standard one. The mean values of the normalized residuals were about $3.56 \cdot 10^{-13}$ for the line search variant, $9.16 \cdot 10^{-13}$ for the standard variant and $1.03 \cdot 10^{-11}$ for **care.** Examples AC18, JE1, NN5, and ROC5, for line search, and JE2, JE3, DLR1− DLR3, ISS1, and ISS2, for standard variant, contributed significantly to the increase of these means.

The mean CPU time for the line search variant was comparable to (but slightly larger than) that for **care**, while for the standard variant, it was about 152% larger. Balancing option somewhat reduced the differences, and line search with balancing was slightly faster than **care**.

CONCLUSIONS

Basic facts and improved procedures and algorithms for solving continuous-time algebraic Riccati equations using standard or modified Newton's method, with several line search strategies, have been presented. Numerical results obtained on a comprehensive set of examples from the COMPl$_e$ib collection have been summarized and they illustrate the performance and capabilities of this new solver. The possibility to offer, in few iterations, a reduction by one or more orders of magnitude of the normalized and MATLAB-style residuals of the solutions computed by MATLAB function **care**, makes the Newton solver an attractive support tool for solving CAREs.

AKNOWLEDGMENT

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ESTIMATING THE AIRPOWER NEEDED TO DESTROY AN ENEMY RUNWAY

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Abstract: *A method and a program instrument for estimating the airpower for destroying an enemy runway is proposed. A simulation model of destroying an enemy runway with arbitrary parameters by any munitions is created. An algorithm of statistical estimation by means of Monte Carlo method is composed. A Matlab object-oriented program implementation is developed. As a result, number of aircraft and munitions are obtained. An accuracy analysis of results with confidence interval and acceptance probability is made.*

Keywords: *estimation, enemy runway, Monte Carlo method, simulation model, destroy, airplane*

1. INTRODUCTION

The task of destroying an enemy runway (RWY) using air power is analytically attributed to classes of complex problems that can be presented with a mathematical description with dificulty. It is possible to solve the task by Monte Carlo method making a simulation model. Mathematical dependencies from the probability theory are used to divide the random magnitude and the probability of realization of the event. A number of simulations are carried out to estimate a solution for the questions asked. The accuracy of the solution obtained can be assessed. The power of modern computing equipment is presented by using classes and objects. Simulated calculation of a chosen random process is presented with a scientific and educational purpose. In the specific case it is estimating the airpower needed to destroy an enemy runway.

2. DESCRIPTION OF THE SIMULATION MODEL FOR DESTROYING AN ENEMY RWY

The main task is to calculate how many planes and ammunition are needed to destroy RWY of a known size. For this purpose a simulation model is created. A pair of planes performs a bomb drop on the RWY of predetermined size. Aiming is along the axis of the RWY estimating to obtain maximum coverage of this specific object. Targeting scheme, for example pair of planes carrying 8 bombs is shown on Fig 1.

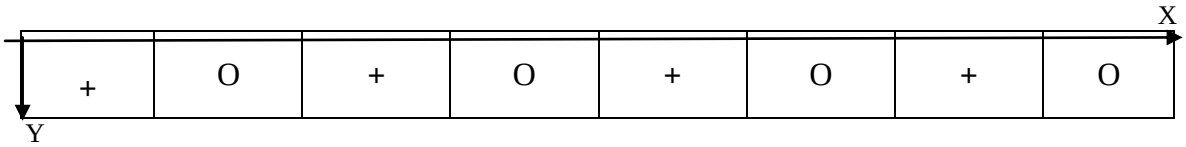

FIG. 1. Targeting scheme, first plane **+**, second **O**

A simulated bomb drop is performed. The distribution of the hits is in accidental law with a normal distribution, knowing the standard deviation X and the standard deviation Y from the aiming point toward "X" and "Y" axes. "X" is the axis of the RWY and "Y" is an axis perpendicular to "X". After each bombing, an assessment of the condition of the runway is made taking into account the size of the bomb crater. Bombings are carried out until the RWY is reported to have been destroyed according to defined criteria.

3. PROGRAM IMPEMENTATION

The following classes and functions have been created: RWY class generating RWY object; bombing simulation function; function for determination of the hits.

The complete simulation model program contains 3 modules: Module for entering input data; Information processing module; Module for outputting results.

The input module can be entered:

- The size of the RWY for destroying - length and width in meters;
- The diameter of the bomb crater in meters;
- The standard deviation X and the standard deviation Y of a bomb from the aiming point in meters;
- The number of bombs carrying an airplane;
- The minimum size of the healthy field under which the RWY is considered to be destroyed. It is impossible take off, length and width in meters;
- The number of simulation tests.

The main part of the program is the information processing module. For applying Monte Carlo method a cycle is performed. The random process is simulated and the results are evaluated in the cycle. The above described bombing is simulated.

4. MATHEMATICAL BASIS

The following formulas are realized in the program [1].

n - Number of attempts;

P - Probability;

σ^2 - Dispersion;

S - Extraction dispersion;

ε - Confidence interval;

α - Confidential probability.

$$\boldsymbol{\sigma} = \sqrt{\frac{\sum_{\boldsymbol{i}=1}^{\boldsymbol{n}} \boldsymbol{Si}^2 - \frac{(\sum_{\boldsymbol{i}=1}^{\boldsymbol{n}} \boldsymbol{Si})^2}{\boldsymbol{n}}}{\boldsymbol{n}-1}} \tag{1}$$

The confidence probability, the confidence interval and the amount of **n** attempts (measurements) are interrelated.

$$\varepsilon = t_\alpha \sqrt{\frac{P(1-P)}{n}}; \qquad n = t_\alpha{}^2 \frac{P(1-P)}{\varepsilon^2}, \text{ for probabilities} \tag{2}$$

$$\varepsilon = t_\alpha \sigma / \sqrt{n}; \qquad n = t_\alpha{}^2 \sigma^2 / \varepsilon^2, \text{ for mathematical expectation} \tag{3}$$

In the above expressions tα is a function of the confidence probability α. tα is derived from the interval integral of the probability for the Gaussian distribution Table 1[1].

Table 1.

α	0.60	0.70	0.80	0.85	0.90	**0.95**	0.99	0.997
tα	0.84	1.04	1.28	1.44	1.65	**1.96**	2.58	2.97

5. RESULTS

The operation of the program is presented in steps. The figurative picture after the first bomb drop is represented on Fig. 2.

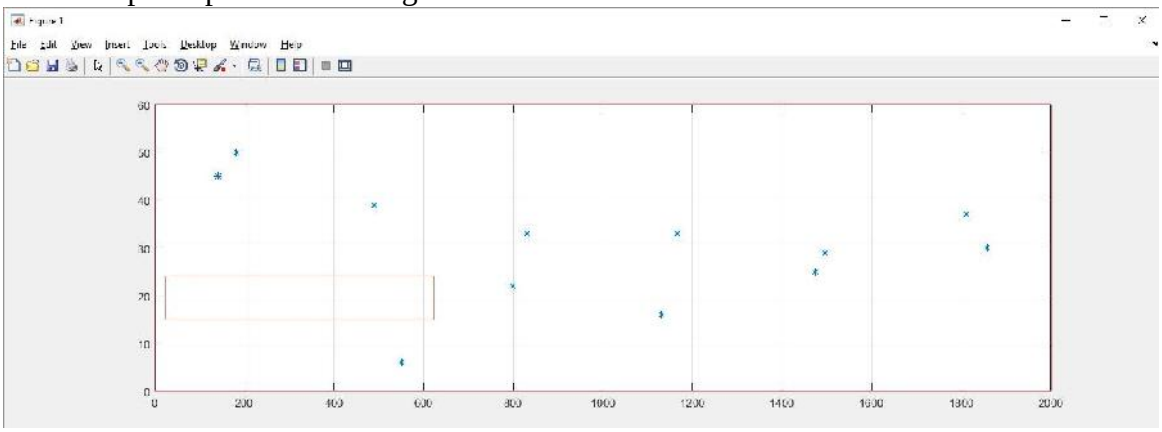

FIG. 2. The RWY is not destroyed because there is a site from which it is possible take off

The next bomb drop is observed on Fig. 3.

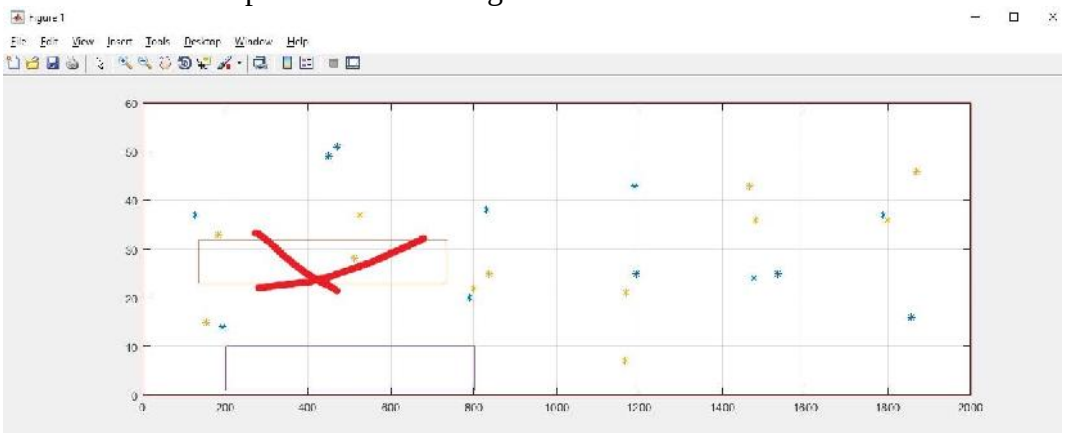

FIG. 3. The RWY is not yet destroyed

After subsequent bomb drops Fig. 4 is observed.

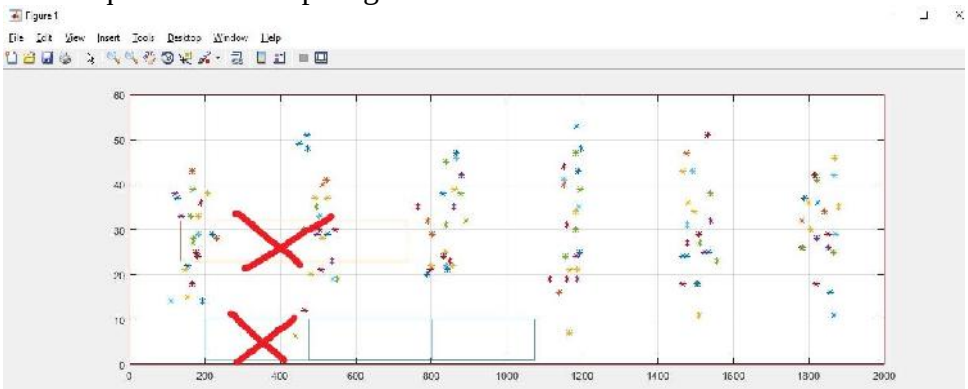

FIG. 4. There is still a take-off site

After a certain number of bombings, Fig. 5 is observed.

FIG. 5. There is no localized field from which take off is possible. The RWY is destroyed.

Figure 6 represents results after program calculation.

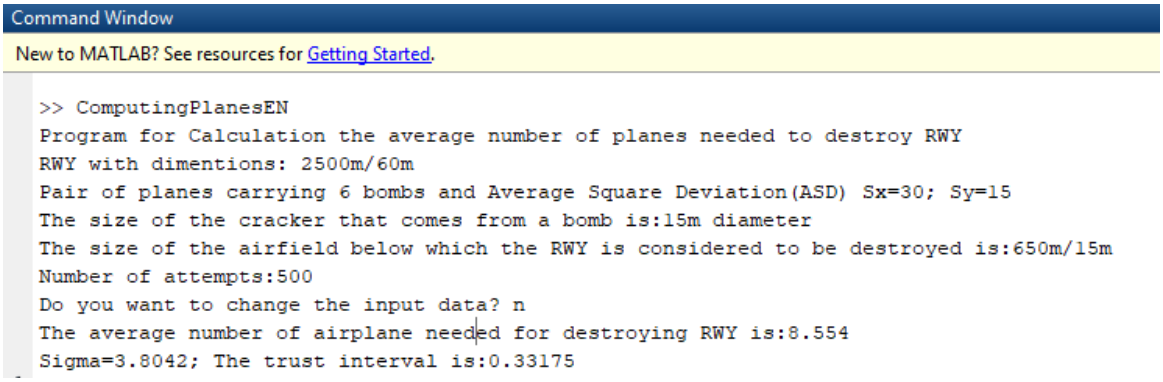

FIG. 6. Final results.

CONCLUSIONS

Based on the Monte Carlo method, the tests set out in the simulation model of the program has resulted in a required number of aircraft needed for destroying a runway with specific dimensions and specified ammunition. The program is also able to calculate the possibility of destroying the runway by a specified number of aircraft pairs. The program provides assessment on the results of the confidence probability and the confidence interval. It is found that wider RWY requires a different targeting scheme.

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THE APPROXIMATION OF A CONTINUOUS FUNCTION USING BERNSTEIN POLYNOMIALS

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Abstract: *The purpose of this article is to prove the Weierstrass theorem that relates to the limit of a convergent uniform polynomial array, in an (a,b) interval, using Bernstein polynomials. The first part of the paper briefly mentions notions connected to the best approximation of an* f *function given by the* P_n *polynomials. It is proven and concluded somehow geometrically, the form of the interpolating Bernstein polynomial* $B_n(x;f)$*, and with the help of the oscillation mode* $\omega(\delta)$ *of the* f *function, the superior limit of the difference* $|f(x)-B_n(x;f)|$ *is determined. The final part of the paper points out the best approximation given by the* $B_n(x;f)$ *polynomials for continuous functions, which close the Weierstrass theorem demonstration.*

Keywords: *approximation, polynomials, functions, continuity, boundedness*

1. INTRODUCTION

If a $f(x)$ function is given, we will say, by definition, that the distance $M(|f-P|)$ between this function and a $P(x)$ polynomial is the error or the approximation where $P(x)$ represents $f(x)$.

For all *n* degree polynomials, $M(|f-P|)$ has an $\mu_n(f)$ inferior margin, which represents the best approximation of the $f(x)$ function using *n* degree polynomials.

The problem of the best approximation is the following:

If a $f(x)$ is given, then the *n* degree polynomials are determined for which $M(|f-P|)$ that reaches its inferior margin $\mu_n(f)$ and this number is studied.

A $P(x)$ polynomial of *n* degree for which $\mu_n(f)$ is reached will be called the best approximation polynomial of *n* degree of the $f(x)$ function.

2. WEIERSTRASS THEOREM

Any continuous function on the (a,b) *interval is the limit of a uniformly convergent array of polynomials in this interval.*

From this theorem we could get $\lim_{n\to\infty+}\mu_n(f)=0$ if the function *f* is continuous.

It is obvious that for any function *f* we have the following inequalities

$\mu_0 \geq \mu_1 \geq \ldots \geq \mu_n \geq \ldots$

So the limit

$\lim_{n\to\infty+} \mu_n(f) = \mu$

Exists and it is higher or equal to zero.

If $\mu = 0$, the polynomial array P_n converges absolutely and uniformly in the (a,b) interval. For a discontinuous function the result is $\mu \neq 0$.

Weierstrass' theorem states that for a continuous function we definitely have $\mu = 0$.

The important issue would be to prove the relation directly, based solely on the P_n polynomials properties.

Before proving the Weierstrass theorem, we state Tonelli' theorem, where the P_n polynomial is noted T_n.

Tonelli's Theorem

If the polynomial array $T_0(x;f), T_1(x;f),....,T_n(x;f),...$ converges absolutely and uniformly towards a continuous function, this function coincides with $f(x)$.

We assume that the polynomial array

$T_0(x;f), T_1(x;f),....,T_n(x;f),...$

Converges uniformly towards a continuous function $F(x)$ and that we have $\mu > 0$, then:

$$M(|f-F|) \le M(|f-T_n|) + M(|F-T_n|) \le \mu_n + M(|F-T_n|)$$

We easily deduce that

$$M(|f-F|) \le \mu_n$$

As $f-F$ is a continuous function, to determine a $\delta > 0$ in any $\le \delta$ length interval, the oscillation of this function has to be smaller than μ.

On the other hand, we can find a number $n > \frac{b-a}{\delta}$ so that we have

$$M(|F-T_n|) < \varepsilon < \frac{\mu}{2}$$

We know that there are $n+2$ points for which $\pm\mu_n$ is alternatively reached and, from the way n was reached, $n > \frac{b-a}{\delta}$, the resultant is the existence, among $n+2$ points, at least 2 points x' and x'' so that

$|x'-x''| < \delta$,

$f(x') - T_n(x') = \mu_n$

$f(x'') - T_n(x'') = -\mu_n$

Where

$$f(x') - F(x') = (f(x') - T_n(x')) + (T_n(x') - F(x')) > \mu_n - \varepsilon \ge \mu - \varepsilon > +\frac{\mu}{2}$$

$$f(x'') - F(x'') = (f(x'') - T_n(x'')) + (T_n(x'') - F(x'')) > -\mu_n + \varepsilon \ge -\mu + \varepsilon > -\frac{\mu}{2}$$

The result is that the oscillation of the $f-F$ function in the $(x';x'')$ interval is higher than μ, which is impossible. The hypothesis $\mu>0$ is wrong. As a result, we must have $\mu=0$ and then *F* coincides with *f*.

3. BERNSTEIN POLYNOMIALS

The purpose is to demonstrate the Weierstrass theorem using Bernstein polynomials.

The definition of Bernstein polynomials

We consider the interval (a,b), with $a<b$, $a,b\in\mathbf{R}$ which we divide in *n* equal parts and let

$$x_i=a+i\cdot\frac{b-a}{n},\quad i=0,1,2,...,n$$

Where $x_0=a$, $x_n=b$.

The definition of the interpolation polynomial

An *n* degree polynomial whose coefficients depend in a linear and homogenous way on the *(n+1)* values $f(x_i)$, $i=0,1,2,...,n$ is called an interpolation polynomial of *n* degree of the $f(x)$ function.

The purpose is to particularly study the Bernstein interpolation polynomial:

$$B_n(x;f)=\frac{1}{(b-a)^n}\sum_{i=0}^{n}C_n^i f(x_i)(x-a)^i(b-x)^{n-i}$$

3.1. A geometrical determination of the Bernstein polynomials

It is interesting to see how these Bernstein polynomials can be obtained in a rather geometrical way.

Let $X_0, X_1, ..., X_n$ be the representative points of the $f(x)$ function for $x=x_0,x_1,...,x_n$, where $x_0=a$, $x_n=b$, that is the coordinate points $X_i(x_i, f(x_i))$, $i=0,1,2,...,n$.

Let's build the polygonal line $X_0X_1...X_n$.

We consider on the sides $X_0X_1, X_1X_2, ..., X_{n-1}X_n$ of the polygonal line the points X'_0, X'_1, ..., X'_{n-1} that divide the sides in the same direction and in the same proportion, so that we can write

$$X_0X'_0=X_1X'_1=X_2X'_2=...=X_{n-1}X'_{n-1}=\frac{k}{n}\cdot\frac{b-a}{n}$$

Where *k* is considered an integer, $0\le k\le n$.

On the polygonal line $X'_0\ X'_1 ... X'_{n-1}$ we mark the polygonal line $X''_0\ X''_1 ... X''_{n-2}$ in the same way, keeping the direction and the proportion of side division, therefore obtaining:

$$X'_0\ X''_0 = X'_1\ X''_1 = X'_2\ X''_2 = ... = X'_{n-2}\ X''_{n-2} = \frac{k}{n} \cdot \frac{b-a}{n}$$

To continue this procedure, we mark the polygonal lines consecutively

$X_0^{(k)}\ X_1^{(k)} ... X_{n-k}^{(k)}$, $k = 3,4,...,n$

The last polygonal line is reduced to a point, that is $X_0^{(n)}$.

Therefore, we obtain the equality:

$$X_0 X'_0 = X'_0\ X''_0 = ... = X_0^{(n-1)} X_0^{(n)} = \frac{k}{n} \cdot \frac{b-a}{n}$$

Thus the abscissa of $X_0^{(n)}$ point is

$$x_k = a + k \cdot \frac{b-a}{n}$$

We note the $X_0^{(n)}$ point with X_k^* to be able to point out the number k and to calculate X_k^*'s ordinate.

We notice that if $i = 0$, X_i point coincides with X_0, respectively with X_n.

We note, generally, with y_k the ordinate of X_k point, with $y_r^{(s)}$ the ordinate of $X_r^{(s)}$ and with y_k^* the ordinate of X_k^*.

We have

$$y_r^{(s)} = \frac{(n-k) \cdot y_r^{(s-1)} + k \cdot y_{r+1}^{(s-1)}}{n}, r = 0,1,...,n-s \text{ and } s = 1,2,...,n-1$$

$$y_r^* = \frac{(n-k) \cdot y_0^{(n-1)} + k \cdot y_1^{(n-1)}}{n}.$$

From the first relation we consecutively deduce that

$$y_r^{(1)} = \frac{(n-k) \cdot y_r + k \cdot y_{r+1}}{n}$$

$$y_r^{(2)} = \frac{(n-k) \cdot y_r^{(1)} + k \cdot y_{r+1}^{(1)}}{n} = \frac{(n-k)^2 + 2k(n-k) \cdot y_{r+1} + k^2 \cdot y_{r+2}}{n^2}$$

And generally

$$y_r^{(s)} = \frac{1}{n^s} \sum_{i=0}^{s} C_s^i \cdot k^i (n-k)^{s-i} y_{r+i}; r = 0,1,...,n-s.$$

$$y_k^* = \frac{1}{n^n} \sum_{i=0}^{n} C_n^i \cdot k^i (n-k)^{n-i} y_i$$

Coming back to the $B_n(x; f)$ polynomial we observe that

$$B_n(a + k \cdot \frac{b-a}{n}; f) = \frac{1}{n^2} \sum_{i=0}^{n} C_n^i \cdot k^i (n-k)^{n-i} f(x_i)$$

Thus the Bernstein polynomial $B_n(x; f)$ is Lagrange's polynomial that takes the y_k^* values in x_k point.

3.2. *Determining a superior limit for* $|f(x)-B_n(x;f)|$

The definition of the oscillation mode $\omega(\delta)$ of a *f* function

Let *f* be a continuous function on the (a,b) interval with $a<b$, $a,b\in\mathbf{R}$.

The oscillation mode of the *f* function is a δ function that, by definition, is given by the relation:

$$\omega(\delta)\overset{def}{=}\max|f(x')-f(x'')|$$

where x' and x'' are two points of the (a,b) interval so that $|x'-x''|\le\delta$.

Observations

a) $\omega(\delta)$ is a definite function for $0<\delta\le b-a$, non-decreasing and non-negative;

b) We have the inequality: $|f(x')-f(x'')|\le\omega(|x'-x''|)$

Statement

The necessary and sufficient condition for *f* to be continuous is that $\omega(\delta)\to 0$ for $\delta\to 0$.

The following observations concerning the statement above are made:

i. For $\varepsilon>0$ there are two x' and x'' points in the (a,b) interval with $x'<x''$ so that $|x'-x''|\le\delta$ And $\omega(\delta)-\varepsilon<|f(x')-f(x'')|$

ii. If we divide the interval (x',x'') in *k* equal parts in the points $x'=x_0;x_1;...;x_{k-1};$ $x_k=x''$ we get

$$f(x')-f(x'')=\sum_{i=1}^{k}\left(f(x_i)-f(x_{i+1})\right)$$

Where

$$|f(x')-f(x'')|\le k\cdot\omega\left(\frac{\delta}{k}\right)$$

So

$$\omega(\delta)<k\omega\left(\frac{\delta}{k}\right)+\varepsilon$$

Whatever ε, and *k* being a positive integer.

Placing $k\cdot\delta$ instead of δ we get

$$\omega(k\delta)<k\omega(\delta)+\varepsilon<(k+1)\omega(\delta)$$

Whatever the positive *k* number so that $\delta\le b-a$ and $k\delta\le b-a$.

Therefore we obtain for $\delta\le b-a$

$$|f(x')-f(x'')|<\left[\frac{|x'-x''|}{\delta}+1\right]\omega(\delta)$$

Thus, the necessary and sufficient condition for *f* to be continuous is that $\omega(\delta)\to 0$ for $\delta\to 0$.

To continue, we plan, with the help of the oscillation module $\omega(\delta)$ to determine the superior limit for $|f(x)-B_n(x;f)|$.

Let's notice that $B_n(x;1)=1$, thus resulting:

$$|f(x)-B_n(x;f)|=\left|\frac{1}{(b-a)^n}\cdot\sum_{i=0}^{n}C_n^i\big(f(x)-f(x_i)\big)\cdot(x-a)^i(b-x)^{n-i}\right|\le$$

$$\le\frac{1}{(b-a)^n}\cdot\sum_{i=0}^{n}C_n^i\omega\big(|x-x_i|\big)\cdot(x-a)^i(b-x)^{n-i}<$$

$$<\left\{\frac{1}{\delta}\cdot\frac{1}{(b-a)^n}\cdot\sum_{i=0}^{n}C_n^i|x-x_i|\cdot(x-a)^i(b-x)^{n-i}+1\right\}\cdot\omega(\delta)$$

If we consider:

$$\Psi(x)=\frac{1}{(b-a)^n}\cdot\sum_{i=0}^{n}C_n^i|x-x_i|\cdot(x-a)^i(b-x)^{n-i}$$

and

$N_n=\max_{x\in(a,b)}\Psi(x)$

and

$\delta=2N_n$, we determine a superior limit for $|f(x)-B_n(x;f)|$ as:

$|f(x)-B_n(x;f)|<\frac{3}{2}\omega(2N_n)$,

for $\delta\le b-a$.

3.3. The approximation given by the $B_n(x;f)$ polynomial

We can calculate the approximation given by the $B_n(x;f)$ polynomials**.**

Let's process first the function $\Psi(x)$.

In the (x_j,x_{j+1}) interval, we have:

$$\Psi(x)=\frac{1}{(b-a)^n}\cdot\sum_{i=0}^{j}C_n^i\big(x-x_i\big)\cdot(x-a)^i(b-x)^{n-i}+$$

$$+\frac{1}{(b-a)^n}\cdot\sum_{i=j+1}^{n}C_n^i\big(x_i-x\big)\cdot(x-a)^i(b-x)^{n-i}=$$

$$=\frac{2}{(b-a)^n}\cdot\sum_{i=0}^{j}C_n^i\big(x-x_i\big)\cdot(x-a)^i(b-x)^{n-i}$$

Because it can be easily checked that:

$$\sum_{i=0}^{n}C_n^i\big(x_i-x\big)\cdot(x-a)^i(b-x)^{n-i}=0$$

By doing the calculus, we find that

$$\Psi(x)=\frac{2}{(b-a)^n}\cdot C_{n-1}^j(x-a)^{j+1}(b-x)^{n-j}$$

The maximum of the polynomial in the (x_j,x_{j+1}) interval is reached for

$$x^*=\frac{(j+1)b+(n-j)a}{n+1}$$

And it has as value

$$\Psi(x^*)=2(b-a)C_{n-1}^j\frac{(j+1)^{j+1}\cdot(n-j)^{n-j}}{(n+1)^{n+1}}=2(b-a)\cdot\lambda_j$$

Where $\lambda_j = C_{n-1}^{j} \frac{(j+1)^{j+1} \cdot (n-j)^{n-j}}{(n+1)^{n+1}}$.

The following observation is useful

As the function $\left(\frac{x+1}{x}\right)^{x+1}$ is decreasing for $x \geq 1$, thus we have:

$$\left(\frac{j+2}{j+1}\right)^{j+2} > \left(\frac{n-j}{n-j-1}\right)^{n-j}$$

for $n > \frac{j+1}{2}$ or $\lambda_{j+1} > \lambda_j$.

Hence the function $\Psi(x^*)$ reaches its maximum for $j = \frac{n}{2}$ or $j = \frac{n-1}{2}$ if *n* is odd or even.

Thus, we have

$$N_n = 2(b-a)C_{n-1}^{n/2} \frac{\left(\frac{n}{2}+1\right)^{\frac{n}{2}+1}\left(\frac{n}{2}\right)^{\frac{n}{2}}}{(n+1)^{n+1}} \text{ for } n \text{ even}$$

$$N_n = \frac{(b-a)}{2^n} C_{n-1}^{n-1/2} \text{ for } n \text{ odd.}$$

It is proven that

$$\sqrt{2n-1} \cdot N_{2n-1} > \sqrt{2n+1} \cdot N_{2n+1}$$

$$N_1 = \frac{(b-a)}{2}, N_3 = \frac{(b-a)}{4}$$

where

$$N_{2n+1} < \frac{b-a}{2\sqrt{2n+1}}$$

$$N_{2n+1} \leq \frac{\sqrt{3}(b-a)}{4\sqrt{2n+1}}$$

for $n \geq 1$.

For *n* even, we have

$$N_{2n} = N_{2n+1} \frac{(n+1)^{n+1} n^n}{(2n+1)^{2n+1}} 2^{2n+1} < N_{2n+1} \frac{2^{2n+1}(n+1)}{(2n+1)^{2n+1}} \left(\frac{2n+1}{2}\right)^{2n} =$$

$$= N_{2n+1} \frac{2(n+1)}{2n+1} \leq \frac{\sqrt{3}(b-a)}{4\sqrt{2n+1}} \cdot \frac{2(n+1)}{2n+1} = \frac{1}{2} \cdot \frac{\sqrt{3}(n+1)(a-b)}{(2n+1)\sqrt{2n+1}} < \frac{b-a}{2\sqrt{2n}}$$

So generally

$$N_n \leq \frac{b-a}{2\sqrt{n}}$$

The relation becomes

$$\left| f(x) - B_n(x; f) \right| < \frac{3}{2} \omega\left(\frac{b-a}{\sqrt{n}}\right)$$

If the function f is continuous $\omega\left(\frac{b-a}{\sqrt{n}}\right)\to 0$ for $n\to\infty$, Weierstrass theorem is demonstrated as well. Moreover, the best approximation of a continuous function is seen using n degree polynomials, that is μ_n, is at least of $\omega\left(\frac{b-a}{\sqrt{n}}\right)$ degree.

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BERNSTEIN POLYNOMIALS IN THE APPROXIMATION AND CONVERGENCE OF DERIVABLE FUNCTIONS

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Abstract *This article points out the properties that the Bernstein polynomials have, related to the approximation of the derivable functions and their convergence, together with the elegant results obtained through problem solving. A continuous function with its first k derivatives is considered on the interval* (a,b) *and it is proven that the Bernstein polynomial arrays* $B_n(f;x)$, $B'_n(f;x),\ldots,\ B_n^{(k)}(f;x)$ *tend absolutely and uniformly towards the functions* $f(x)$, $f'(x),\ldots,$ $f^{(k)}(x)$ *respectively, on the entire* (a,b) *interval.*

Keywords: *approximation, polynomials, functions, continuity, boundedness*

1. INTRODUCTION

Let $f(x)$ be a continuous function on the (a,b). We divide the interval (a,b) in *n* equal parts and we get:

$$x_i = a + i\frac{b-a}{n} \tag{1}$$

Division points, where $i = 0,1,\ldots,n$, with $x_0 = a$; $x_n = b$.

An *n* degree polynomial whose coefficients depend linearly and homogenously on the *(n+1)* values $f(x_i)$ with $i = \overline{0,n}$ is called an *n* degree interpolation polynomial of the $f(x)$ function.

We note with

$$B_n(f;x) = \frac{1}{(b-a)^n}\sum_{i=0}^{n} C_n^i f(x_i)\cdot(x-a)^i(b-x)^{n-i} \tag{2}$$

The Bernstein interpolation polynomial.

Also, the oscillation module of the *f* function is defined by

$$\omega(\delta) = \max\left|f(x') - f(x'')\right| \tag{3}$$

Where x' and x'' are two ordinary points of the (a,b) interval with the property

$$\left|x'-x''\right| \le \delta, \text{ where } \quad \delta \in (0, b-a] \tag{4}$$

We mark the divided difference by the order $(k-1)$ of the *f* function in the points $x_1, x_2,\ldots,x_k$ with

$$D_k = \frac{U(x_1,x_2,\ldots,x_k;f)}{V(x_1,x_2,\ldots,x_k)} \tag{5}$$

As being the relation between the two determinants: $U(x_1, x_2,...,x_k; f)$ being the determinant obtained from the Vandermonde determinant of $V(x_1, x_2,...,x_k)$ of the numbers $x_1, x_2,...,x_k$, replacing the last respective column with the elements $f(x_1), f(x_2),..., f(x_k)$ and the determinant $V(x_1, x_2,...,x_k)$.

We note $D_k = [x_1, x_2,...,x_k; f]$ the difference divided by the $(k-1)$ order of the $f(x)$ function.

We note with $D_n[f] = \max_{(a,b)} |[x_1, x_2,...,x_{n+1}; f]|$ the limit of the n order of the f function in (a,b) interval, where $x_1, x_2,...,x_{n+1}$ are $(n+1)$ random distinct points of the (a,b) interval.

If f admits a bounded derivative of an $(n+1)$ order and if we note with $D_0[f^{(n+1)}]$ the maximum or the superior limit of $\left|f^{(n+1)}\right|$ in the interval (a,b) we have

$$D_0[f^{(n+1)}] = (n+1)!D_{n+1}[f] \tag{6}$$

2. THE APPROXIMATION OF THE DERIVATIVE FUNCTIONS

Let's assume that the f function has a continuous derivative of *k* order and let $\omega_k(\delta)$ be the oscillation module of this derivative.

It is known that we have the generalized mean formula:

$$k!D_k^i = f^{(k)}\left(a + \frac{b-a}{n}(i+\theta k)\right), 0 < \theta < 1 \tag{7}$$

where $D_k^i = [x_i, x_{i+1},...,x_{i+k}; f]$, $i = 0,1,...,n-k$, $k = 1,2,...$

$$\left|k!D_k^i - f^{(k)}\right| \le \omega_k\left(\left|x - a - \frac{b-a}{n}(i+\theta k)\right|\right) \le \omega_k\left(\max\left(|x-x_i|, |x-x_{i+1}|,...,|x-x_{i+k}|\right)\right) \tag{8}$$

In the following, we consider the polynomial:

$$Q_{n,k}(f;x) = \frac{B_n^{(k)}(f;x)}{\left(1-\frac{1}{n}\right)\left(1-\frac{2}{n}\right)...\left(1-\frac{k-1}{n}\right)} = \frac{1}{(b-a)^{n-k}}\sum_{i=0}^{n-k} C_{n-k}^i k!D_k^i (x-a)^i (b-x)^{n-k-i} \tag{9}$$

We have

$$\left|f^{(k)} - Q_{n,k}(f;x)\right| < \left\{\frac{1}{\delta}\left(\frac{1}{(b-a)^{n-k}}\cdot\sum_{i=0}^{s} C_{n-k}^i |x-x_i|(x-a)^i(b-x)^{n-k-i} + \right.\right.$$
$$\left.\left. + \frac{1}{(b-a)^{n-k}}\cdot\sum_{i=s+1}^{n-k} C_{n-k}^i |x-x_{i+k}|(x-a)^i(b-x)^{n-k-i}\right) + 1\right\}\cdot\omega_k(\delta) \tag{10}$$

Where s is determined as follows:

$$s = j - \frac{k}{2} \text{ if } k \text{ is even and } x_j \le x \le x_{j+1} \tag{11}$$

$$s = j - \frac{k+1}{2} \text{ If } k \text{ is odd and } x_j \le x \le \frac{x_j + x_{j+1}}{2} \tag{12}$$

$$s = j - \frac{k-1}{2} \text{ if } k \text{ is odd and } \frac{x_j + x_{j+1}}{2} \le x \le x_{j+1} \tag{13}$$

If in these formulae we have $s<0$ or $s\geq n-k$, either the first or the second member in the second parenthesis of the (10) relation disappears.

We notice that

$$\left|x-x_{i+k}\right|\leq\left|x-x_i\right|+\left|x_{i+k}-x_i\right|-\left|x-x_i\right|+\frac{k(b-a)}{n} \tag{14}$$

$$\left|f^{(k)}-Q_{n,k}(f;x)\right|=\left\{\frac{1}{\delta}\left(\frac{1}{(b-a)^{n-k}}\cdot\sum_{i=0}^{n-k}C_{n-k}^{i}\left|x-x_i\right|(x-a)^i(b-x)^{n-k-i}+\Psi(x)\right)+1\right\}\cdot\omega_k(\delta) \tag{15}$$

Where

$$\Psi(x)=\frac{k}{n}\cdot\frac{1}{(b-a)^{n-k-1}}\cdot\sum_{i=s+1}^{n-k}C_{n-k}^{i}(x-a)^i(b-x)^{n-k-i} \tag{16}$$

And we must consider $\Psi(x)=0$ if $s\geq n-k$.

Let's further notice that

$$\begin{aligned}\frac{1}{(b-a)^{n-k}}\cdot\sum_{i=0}^{n-k}C_{n-k}^{i}\left|x-x_i\right|(x-a)^i(b-x)^{n-k-i}\leq\\ \leq\frac{1}{(b-a)^{n-k}}\cdot\sum_{i=0}^{n-k}C_{n-k}^{i}\left|x-a-i\frac{b-a}{n-k}\right|(x-a)^i(b-x)^{n-k-i}+\\ +\frac{k}{n(n-k)(b-a)^{n-k-1}}\cdot\sum_{i=0}^{n-k}C_{n-k}^{i}i(x-a)^i(b-x)^{n-k-i}\end{aligned} \tag{17}$$

That results from the relation

$$x-x_i=x-a-i\frac{(b-a)}{n}+i\frac{k(b-a)}{n(n-k)} \tag{18}$$

It is known that

$$\frac{1}{(b-a)^{n-k}}\cdot\sum_{i=0}^{n-k}C_{n-k}^{i}\left|x-a-i\frac{b-a}{n-k}\right|(x-a)^i(b-x)^{n-k-i}\leq\frac{b-a}{2\sqrt{n-k}} \tag{19}$$

On the other hand

$$\frac{k}{n(n-k)(b-a)^{n-k-1}}\cdot\sum_{i=0}^{n-k}C_{n-k}^{i}i(x-a)^i(b-x)^{n-k-i}=\frac{k(x-a)}{n} \tag{20}$$

In these conditions we write:

$$\frac{1}{(b-a)^{n-k}}\cdot\sum_{i=0}^{n-k}C_{n-k}^{i}\left|x-a_i\right|(x-a)^i(b-x)^{n-k-i}\leq\frac{b-a}{2\sqrt{n-k}}+\frac{k(b-a)}{n} \tag{21}$$

We obviously obtain for the function $\Psi(x)$ the inequality:

$$\Psi(x)\leq\frac{k}{n}\cdot\frac{1}{(b-a)^{n-k-1}}\cdot\sum_{i=0}^{n-k}C_{n-k}^{i}(x-a)^i(b-x)^{n-k-i}=\frac{k(b-a)}{n} \tag{22}$$

Thus resulting in:

$$\left|f^{(k)}-Q_{n,k}(f;x)\right|<\left\{\frac{1}{\delta}\left(\frac{b-a}{2\sqrt{n-k}}+\frac{2k(b-a)}{n}\right)+1\right\}\cdot\omega_k(\delta) \tag{23}$$

We consider $\delta=\frac{b-a}{\sqrt{n-k}}$ obtaining:

$$\left|f^{(k)}-Q_{n,k}(f;x)\right|<\left(\frac{3}{2}+\frac{2k\sqrt{n-k}}{n}\right)\omega_k\left(\frac{b-a}{\sqrt{n-k}}\right)\leq\frac{3+2\sqrt{k}}{2}\omega_k\left(\frac{b-a}{\sqrt{n-k}}\right) \tag{24}$$

with $n\geq k+1$.

3. THE CONVERGENCE OF BERNSTEIN POLYNOMIALS DERIVATIVES

If $D_k^i = [x_i, x_{i+1},...,x_{i+k}; f]$, $i = 0,1,...,n-k$, $k = 1,2,...$ a simple calculus shows that

$$B_n^{(k)}(f;x) = \frac{dB_n(f;x)}{dx} = \frac{1}{(b-a)^{n-1}} \sum_{i=0}^{n-1} C_{n-1}^i D_1^i (x-a)^i (b-x)^{n-1-i} \tag{25}$$

And generally:

$$\frac{d^k B_n(f;x)}{dx} = k!\left(1-\frac{1}{n}\right)\left(1-\frac{2}{n}\right)..\left(1-\frac{k-1}{n}\right)\frac{1}{(b-a)^{n-k}} \sum_{i=0}^{n-1} C_{n-k}^i D_k^i (x-a)^i (b-x)^{n-k-i} \tag{26}$$

As the derivative of a *k* order of function f is supposed to be continuous, the superior border $D_0[f^{(k)}]$ is then finite.

We write

$$f^{(k)} - B_n^{(k)}(f;x) = f^{(k)} - Q_{n,k}(f;x) + \left[1-\left(1-\frac{1}{n}\right)\left(1-\frac{2}{n}\right)..\left(1-\frac{k-1}{n}\right)\right]\cdot Q_{n,k}(f;x) \tag{27}$$

How

$$\left|Q_{n,k}(f;x)\right| \le D_0\left[f^{(k)}\right] \tag{28}$$

And

$$1-\left(1-\frac{1}{n}\right)\left(1-\frac{2}{n}\right)..\left(1-\frac{k-1}{n}\right) \tag{29}$$

Taking into consideration the relation (24), we deduce:

$$\left|f^{(k)} - B_n^{(k)}(f;x)\right| < \frac{3+2\sqrt{k}}{2}\cdot\omega_k\left(\frac{b-a}{\sqrt{n-k}}\right) + \frac{k(k-1)}{2n}\cdot D_0\left[f^{(k)}\right] \tag{30}$$

This shows that:

If function f, definite in the interval (a,b), is continuous together with its first *k* derivatives, the polynomial arrays $B_n(f;x)$, $B'_n(f;x),...,$ $B_n^{(k)}(f;x)$ tend absolutely and uniformly towards $f(x)$, $f'(x),...,$ $f^{(k)}(x)$ respectively, on the entire (a,b) interval.

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FIXED POINT THEOREM FOR φ_M-GERAGHTY CONTRACTIONS

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Abstract: *In this paper we extend the result of Geraghty([4],[5]) about φ- contractions, starting from the papers of O.Popescu([7]) respectively A.Fulga, A. Proca ([2]). We introduce a new notation and we establish a fixed point theorem for such mapping in a complete metric space.*

Keywords: *fixed point, φ- contractions, contractions.*

1. INTRODUCTION

Because of its importance in mathematics and specially in fixed point theory, a lot of authors ([6],[7],[8],[9]) gave generalizations of Banach contraction principle [1]. One of the most well-known generalizations is given by Geraghty[5].

In this paper, starting from [7] and [2], we introduce the notion of φ_M-Geraghty contraction and prove a fixed point theorem for φ_M-contractions, which generalized theorem (1.1).

Theoreme (1.1) Let (X,d) be a complete metric space and T:X→X be an operator. If T satisfies the following inequality:

$$d(Tx,Ty) \leq \varphi\big(d(x,y)\big) \cdot d(x,y), \forall x,y \in X, \tag{1.1}$$

where $\varphi: [0,\infty) \to [0,1)$ is a function which satisfies the condition

$$\lim_{n\to\infty} \varphi(t_n) = 1 \Rightarrow \lim_{n\to\infty} t_n = 0 \tag{1.2}$$

then T has a unique fixed point.

2. MAIN RESULTS

Definition (2.1) Let (X,d) be a metric space. A mapping T:X→X is said to be a φ_E-Geraghty contraction on (X,d) if there exists $\varphi \in \emptyset$ such that

$$d(Tx,Ty) \leq \varphi\big(E(x,y)\big)E(x,y), \forall x,y \in X,$$

where

$$E(x,y) = d(x,y) + |d(x,Tx) - d(y,Ty|$$

and $\emptyset$ denote the class of functions $\varphi: [0,\infty) \to [0,1)$ which satisfies the condition:

$$\lim_{n\to\infty} \varphi(t_n) = 1 \Rightarrow \lim_{n\to\infty} t_n = 0 \tag{2.1}$$

Theorem (2.1) Let (X,d) be a complete metric space and T:X→X be an φ_E-Geraghty contraction. Then T has a unique fixed point $x^* \in X$ and for all $x_0 \in X$ the sequence $\{T^n x_0\}$ is convergent to x^*.

Definition (2.2) Let (X,d) be a metric space. A mapping T:X→X is said to be a φ_M −Geraghty contraction on (X,d) if there exists $\varphi \in \emptyset$ such that

$$d(Tx,Ty) \leq \varphi\big(M(x,y)\big)M(x,y) \tag{2.2}$$

where

$$M(x,y) = \max\{d(x,y) + |d(x,Tx) - d(y,Ty)|; d(x,Tx) + |d(x,y) - d(y,Ty)|; \tag{2.3}$$

$$d(y,Ty) + |d(x,y) - d(x,Tx)|; \frac{d(x,Ty) + d(y,Tx) + |d(x,Tx) - d(y,Ty)|}{2}\}$$

and $\emptyset$ denote the class of functions $\varphi: [0,\infty) \to [0,1)$which satisfies the condition:
$\lim_{n\to\infty} \varphi(t_n) = 1 \Rightarrow \lim_{n\to\infty} t_n = 0$.

Theorem(2.1) Let (X,d) be a complete metric space and T:X→X be φ_M-Geraghty contraction. Then T has a unique fixed point $x^* \in X$ and for all $x_0 \in X$ the sequence $\{T^n x_0\}$ is convergent to x^*.

Demonstration:

Let $x_0 \in X$, arbitrary, fixed, with $x_{n+1} = Tx_n = T^n x_0$, then x_0 is fixed point for T. We can suppose that $x_n \neq x_{n+1}$, for all natural *n* so it results $d(x_n, x_{n+1}) > 0, \forall n \in N$.

If we denote $d(x_n, x_{n+1}) = d_n$ and put x=x_n and y=x_{n+1} in (2.2)

$d(Tx,Ty) \leq \varphi\big(M(x,y)\big) \cdot M(x,y)$, where φ:[0,∞) → [0,1) and

$[\varphi(t_n) \to 1] \Rightarrow t_n \to 0$, we obtain

$$d(Tx_n, Tx_{n+1}) \leq \varphi\big(M(x_n, x_{n+1})\big) \cdot M(x_n, x_{n+1}).$$

$$M(x_n, x_{n+1}) = \max\{d_n + |d_n - d_{n+1}|; d_n + |d_n - d_{n+1}|,$$
$$d_{n+1} + |d_n - d_n|, \frac{d(x_n, x_{n+2}) + d(x_{n+1}, x_{n+1}) + |d_n - d_{n+1})|}{2}\}$$

If $d_{n+1} > d_n \Rightarrow$

$$M(x_n, x_{n+1}) = max\left\{d_{n+1}, \frac{d(x_n, x_{n+2}) + d_{n+1} - d_n}{2}\right\}$$

But

$$\frac{d(x_n,x_{n+2})+d_{n+1}-d_n}{2} \leq \frac{d_n+d_{n+1}+d_{n+1}-d_n}{2} = d_{n+1}$$

So we have $M(x_n,x_{n+1}) = d_{n+1}$.

From the assumption on the theorem we get

$d(x_{n+1},x_{n+2}) \leq \varphi(d_{n+1}) \cdot d_{n+1}$, and we obtain
$d_{n+1} \leq \varphi(d_{n+1}) < d_{n+1}$,

which is a contradiction.

If $d_n > d_{n+1}$, we have

$$M(x_n,x_{n+1}) = max\left\{2d_n - d_{n+1}, d_{n+1}, \frac{d(x_n,x_{n+2})+d_n-d_{n+1}}{2}\right\}$$

But $2d_n - d_{n+1} > d_{n+1}$, and

$$\frac{d(x_n,x_{n+2})+d_n-d_{n+1}}{2} \leq \frac{d_n+d_{n+1}+d_n-d_{n+1}}{2} = d_n$$

$$2d_n - d_{n+1} = d_n + (d_n - d_{n+1}) > d_n.$$

So $M(x_n,x_{n+1}) = 2d_n - d_{n+1}$

From the assumption of the theorem, we get

$$d(x_{n+1},x_{n+2}) \leq \varphi(2d_n - d_{n+1}) \cdot (2d_n - d_{n+1})$$

$$d_{n+1} \leq \varphi(2d_n - d_{n+1})(2d_n - d_{n+1}) \qquad (2.4)$$

$$d_{n+1} \leq 2d_n - d_{n+1}$$

Therefore $d_n \geq d_{n+1}, \forall n \in \mathbb{N}$.

Let $d = \lim_{n\to\infty} d_n$ and we suppose that $d > 0$. Taking the limit as $n \to \infty$ in (2.4) we get

$$d \leq \lim_{n\to\infty}[\varphi(2d_n - d_{n+1}) \cdot (2d_n - d_{n+1})] \leq \lim_{n\to\infty}(2d_n - d_{n+1})$$

$$d \leq \lim_{n\to\infty}\varphi(2d_n - d_{n+1}) \cdot d \leq d$$

$$\Rightarrow \lim_{n\to\infty} \varphi(2d_n - d_{n+1}) = 1 \qquad \Rightarrow \lim_{n\to\infty} (2d_n - d_{n+1}) = 0 \quad \Rightarrow d = 0.$$

We prove now, that $\{x_n\}$ is a Cauchy sequence. Suppose, on the contrary, that there exists $\varepsilon > 0$ and$\{n(k)\},\{m(k)\} \subset \mathbb{N}$,n$(k) > m(k) > k$, such that

$$d\left(x_{n(k)}, x_{m(k)}\right) \geq \varepsilon, d\left(x_{n(k)-1}, x_{m(k)}\right) < \varepsilon, (\forall)k \in \mathbb{N}. \tag{2.5}$$

Using the triangle inequality and (2.5), we get:

$$\varepsilon \leq d\left(x_{n(k)}, x_{m(k)}\right) \leq d\left(x_{n(k)}, x_{n(k)-1}\right) + d\left(x_{n(k)-1}, x_{m(k)}\right). \tag{2.6}$$

Taking the limit as $k \to \infty$ in (2.6) and using (2.5) we obtain

$$\lim_{n\to\infty} d\left(x_{n(k)}, x_{m(k)}\right) = \varepsilon \tag{2.7}$$

Also

$$\left|d\left(x_{n(k)+1}, x_{m(k)+1}\right) - d\left(x_{n(k)}, x_{m(k)}\right)\right| \leq$$
$$\leq d\left(x_{n(k)}, x_{n(k)+1}\right) + d\left(x_{m(k)}, x_{m(k)+1}\right), \tag{2.8}$$
$$and \lim_{n\to\infty} d\left(x_{n(k)+1}, x_{m(k)+1}\right) = \varepsilon$$

Putting $x = x_{n(k)-1}, y = x_{m(k)-1}$ in relation (2.2) we deduce

$$\varepsilon \leq d\left(x_{n(k)}, x_{m(k)}\right) \leq$$

$$\leq \varphi\left(M(x_{n(k)-1}, x_{m(k)-1})\right) \cdot M(x_{n(k)-1}, x_{m(k)-1}), (\forall)k \in \mathbb{N}. \tag{2.9}$$

where

$$M(x_{n(k)-1}, x_{m(k)-1}) =$$
$$\max\{d\left(x_{n(k)-1}, x_{m(k)-1}\right) + \left|d\left(x_{n(k)-1}, x_{n(k)}\right) - d(x_{m(k)-1}, x_{m(k)}\right|,$$
$$d\left(x_{n(k)-1}, x_{n(k)}\right) + \left|d(x_{n(k)-1}, x_{m(k)-1}) - d(x_{m(k)-1}, x_{m(k)})\right|,$$
$$d\left(x_{m(k)-1}, x_{n(k)}\right) + \left|d(x_{n(k)-1}, x_{m(k)-1}) - d(x_{n(k)-1}, x_{n(k)})\right|,$$
$$\frac{1}{2}\left[d(x_{n(k)-1}, x_{m(k)}) + d(x_{m(k)-1}, x_{n(k)}) + \left|d(x_{n(k)-1}, x_{n(k)}) - d(x_{m(k)-1}, x_{m(k)})\right|\right]\}$$

We observe that

$$\lim_{k\to\infty} M(x_{n(k)-1}, x_{m(k)-1}) = \varepsilon > 0 \tag{2.10}$$

Taking the limit as $k \to \infty$ in (2.9) and using (2.10) we obtain

$$\varepsilon \leq \lim_{k\to\infty} d(x_{n(k)-1}, x_{m(k)-1}) \leq$$

$$\leq \lim_{k\to\infty} \left[\varphi\left(M(x_{n(k)-1}, x_{m(k)-1})\right) \cdot M(x_{n(k)-1}, x_{m(k)-1})\right] < \varepsilon,$$

and

$$\lim_{k\to\infty} \left(M(x_{n(k)-1}, x_{m(k)-1})\right) \cdot \varepsilon = \varepsilon,$$

so

$$\lim_{k\to\infty} \varphi\left(M(x_{n(k)-1}, x_{m(k)-1})\right) = 1 \Rightarrow$$

$$\Rightarrow \lim_{k\to\infty} M(x_{n(k)-1}, x_{m(k)-1}) = 0,$$

which is a contradiction.

Therefore $\{x_n\}$ is a Cauchy sequence. By completeness of (X, d),$\{x_n\}$ is convergent to

$$x^* \in X \text{ and } \lim_{k\to\infty} d(x_n, x^*) = 0 \tag{2.11}$$

Finally, we will show that $x^* = Tx^*$. We put $x = x_n$ and $y = x^*$ in (2.2):

$$d(Tx_n, Tx^*) \leq \varphi\left(M(x_n, x^*)\right) \cdot M(x_n, x^*)$$

$$d(x_{n+1}, Tx^*) \leq \varphi\left(M^*(x_n, x^*)\right) \cdot M^*(x_n, x^*) \tag{2.12}$$

$$M(x_n, x^*) = max\{d(x_n, x^*) + |d(x_n, Tx_n) - d(x^*, Tx^*)|,$$

$$d(x_n, x_{n+1}) + |d(x_n, x^*) - d(x^*, Tx^*)|,$$

$$d(x^*, Tx^*) + \left|d(x_n, x_{n+1}) - d\left(x_n, x^*\right)\right|,$$

$$\frac{1}{2}[d(x_n, Tx^*) + d(x^*, x_{n+1}) + |d(x_n, x_{n+1}) - d(x^*, Tx^*)|\} \tag{2.13}$$

$$\lim_{n\to\infty} M(x_n, x^*) = d(x^*, Tx^*) \tag{2.14}$$

Taking the limit as $n \to \infty$ in (2.12) and using (2.14) we get:

$$d(x^*, Tx^*) \leq \lim_{n\to\infty} \varphi\left(M(x_n, x^*)\right) \cdot d(x^*, Tx^*) < d(x^*, Tx^*)$$

$$\lim_{n\to\infty}\varphi\big(M(x_n,x^*)\big)=1,\lim_{n\to\infty}M(x_n,x^*)=0\Rightarrow\ d(x^*,Tx^*)=0$$

Hence, $x^*=Tx^*$.

Now, let us to show that T has at most one fixed point.

Indeed, if $x^*,y^*\in X$ are two distinct fixed points of T, that is, $Tx^*=x^*\neq y^*=Ty^*$, then

$$0<d(x^*,y^*)=d(Tx^*,Ty^*)\leq\varphi\big(M(x^*,y^*)\big)\cdot M(x^*,y^*) \tag{2.15}$$

Because

$$M(x^*,y^*)=\max\{d(x^*,y^*)+\left|d(x^*,Tx^*)-d(y^*,Ty^*)\right|,$$

$$d(x^*,Tx^*)+\left|d(x^*,y^*)-d(y^*,Ty^*)\right|,$$

$$d(y^*,Ty^*)+\left|d(x^*,y^*)-d(x^*,Tx^*)\right|,\frac{d(x^*,Ty^*)+d(y^*,Tx^*)+\left|d(x^*,Tx^*)-d(y^*,Ty^*)\right|}{2}\}=$$

$=d(x^*,y^*)$, it follows from (2.15) that

$$0<d(x^*,y^*)\leq\varphi\big(d(x^*,y^*)\big)d(x^*,y^*)<d(x^*,y^*).$$

This is a contradiction. Then $d(x^*,y^*)=0$, so $x^*=y^*$. This proves than the fixed point of T is unique.

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ABOUT EDUCATION AS A FUNDAMENTAL HUMAN DIMENSION

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Abstract:*People are, above all, cultural beings; the central elements of culture are values, they direct the spirit of any culture and function as a selective grid towards cultural creation and diffusion. Culture involves all the products of human activity, values and modes of behavior objected by certain communities to other human communities and subsequent generations. As a global process, education could be characterized as a quick and abridged recapitulation - because it is selective - of the cultural experience of humanity as a whole and, in particular, the experience of the community and the reference group.*

Biopsychological maturation processes, socialization and culture can only be conceived through intimate correlation, they are three facets of a single process. Therefore, the mature psychological individual, the social and the cultural being are just hypostases of the Ego, because it is an existential unity.

Key words*: education, existential unity, open cultural finality, cultural being.*

1. EDUCATIONAL THEORIES

Educability is the ability of man to benefit from the action of education and to achieve in this way accumulations on the behavioral plane. At the basis of the psychological development and evolution of the human personality lies:

- internal factors (heredity, individual experience);
- external factors (education, environment).

Educability is the significant characteristic of the human being to designate the capacity to be receptive to educational influences and to achieve accumulations materialized in personality structures.

Hereditary (inherent) theory. The advocates of this theory believe that internal factors underlie psychic development and personality evolution. According to them, man is born with a multitude of skills that can not be exchanged through education. They minimize or even deny the role of external factors. According to John Lock, the child's soul at birth is a "tabula rasa", a blackboard on which any kind of information can be engraved. Heredarians believe that at birth all children are equal, the differences between them being due to education and the environment. This minimizes the role of internal factors.

The theory of double determination. This theory includes four fundamental contributions: Freud (psychoanalysis), Plaget (construction of genetic mutations), Wallon (person building), Vagoski (personality development should be seen as a self-development determined by the interaction of internal and external factors). This theory determines the weight of internal and external factors in the development of personality as well as the ways of interaction between them.

There are three major foundations of education:

- slow anatomophisiological maturation of the human being;
- the predominance of intelligent behaviors on instinctive;
- the essential role of socioculturalization in human anthropogenesis and human ontogenesis.

These major fundamentals show once again that education is one cumulation of biological, psychological and socio-cultural factors. Totalitarian political and educational systems have replaced education with a permanent "general" training, leading to the emergence of "new man" as the product of this de-training process.

Almost all traditional pedagogy brings to light such a conception of education. Even today, some educators prefer training techniques to training conscious processes for reasons of "efficiency or time-saving". As if the purpose of education would be a quick storage of knowledge, skills and abilities, and not the formation of a complete and harmonious personality, through the collaboration between the educational ideal and the cultural ideal of the individual.

Man is, above all, a cultural being; the central elements of culture are values, they direct the spirit of any culture and function as a selective grid towards cultural creation and diffusion. Culture involves all the products of human activity, values and modes of behavior objected by certain communities to other human communities and subsequent generations.

As a global process, education could be characterized as a quick and abridged recapitulation - because it is selective - of the cultural experience of humanity as a whole and, in particular, the experience of the community and the reference group.

The values of culture in its entirety are virtually unlimited, but three major categories of values can be distinguished:

a) Eternal human values - are the values related to the generic man, promoted by the double millennium of humanism, the values of classical Greek culture and the "universal man" of the Renaissance, from Christian mercy to the modern scientific spirit; these values form what we usually call the "cultural patrimony of humanity".

b) The values of the national community - are those established over the history of that community; have the character of stability and certainty, by virtue of their preservation in the national cultural heritage; some of them succeed in penetrating the universal patrimony, others retain their idiomatic character.

c) Values of the century - are specific to a certain age in the history of the world and the community, are unstable and unreliable values because they have not been subjected to time, but they also introduce novelty, prove the originality and creativity of that era; some of them will be selected, others will not, but it is certain that there are no perfect spiritual desert eras.

Finding a fair balance, a fair measure between these three value categories is one of the most striking problems for any education system. Whoever manages to solve this problem has actually solved the issue of educational content. To put the center of culture at the heart of values is, at the educational level, to put the core of the content of education, all its values. But doing so means recognizing a necessary shift of focus - the shift from the predominance of instruction to that of education proper, from in-formative to formative.

There is a need for another education - dynamic, formative, value-centered. Mentalities can only be changed through education. At present, this is still strongly marked by the de-training of trainers, after half a century of ideological pressure on education and education, but also by the fact that new orientations and educational technologies penetrate slowly and with great difficulty in our East European space.

When information is treasured in treaties, archives, encyclopaedias, dictionaries, libraries, databases, almost all accessible, it would be absurd to limit education to a simple storage and storage operation.

A well-formed individual, so armed with the techniques and strategies of orientation in the world of culture, educated in the spiritual values, will succeed in correctly forming whenever he or she will feel the need or will have to feel this need.

A fundamental need, the lack of which is intense, is the rediscovery of the role of models in education, the re-enactment of a pedagogy of models, whose meaning was lost in our time. Like values, models have a rather formative role, they are in fact an embodiment of values.

2. ROLE - STATUS RELATIONSHIP - CULTURAL MODEL

Biopsychological maturation processes, socialization and culture can only be conceived through intimate correlation, they are three facets of a single process. Therefore, the mature psychological individual, the social and the cultural being are just hypostases of the Ego, because it is an existential unity.

In order to understand this process - education - we need to call upon the concepts of status, role, cultural model, ideal personality and educational ideal. Quoted clearly for the first time by American H. H. Mead, these concepts are defined as:

- *The role* - close to the concept of attitude - implies a self-concept in relation to the group, understood as a generalized ALT.

- *Status* - represents the place, the position occupied in a social system, of any subject.

Role refers to the cultural patterns associated with that status; the cultural model,

status and role must be seen in their intimate interdependence - the cultural model defines the status, gives it "substance", and it manifests itself through the role as a "role play".

The subject is under the influence of a practically undetermined number of cultural models that contribute to its formation. These are offered by the family, social proximity, educational system, and all of its socio-cultural experience. These intensely formative contacts contribute to shaping the cultural ideal of personality.

For any educational system, the most important issue is the quality of the models offered, because without doubt the quality of the cultural ideal is directly dependent on the quality of the model offer. The cultural ideal is structured following an uninterrupted "struggle of models", which does not end at full maturity, and man is in fact an open-cultural being. The cultural ideal is formed in childhood and adolescence, it is interiorized and structured to maturity and becomes the foundation upon which the entire personality of the individual, the totality of his acts and capacities, his function as a cultural being. Between education and the cultural ideal there is a relationship of mutual influence, never interrupted. Education, through the cultural models offered, is the one that structures the cultural ideal. The issue of the variety of models is, of course, important, but more important is their quality.

It is the cultural ideal that gives the person his own style of referring to culture. Through this very complicated dialectic of status, role, cultural, dialectical models we can call education with one word, man becomes what is essentially a cultural being.

3. EDUCATIONAL IDEAL AS A DESIRABLE PERSONALITY

We can not conceive an education lacking an educational ideal. Education always aims at something specific - the formation of its subjects in the spirit of a certain configuration of values considered essential by the community in which an educational system operates or another.

The educational ideal is the result of a "smart compromise" negotiated between the educational system, the system of culture and the social macrosystem. At the community level of the macro system, the issue of the educational ideal is a policy of education and education.

Every society aims to form individuals in the spirit of the values that characterize it, in which it believes and wishes to preserve them. So the educational ideal represents, from this point of view, the type of personality that the respective community wants to form and multiply it among its future citizens. It's the type of desirable personality. In the practice of education, the educational ideal is concretized into educational goals and objectives, from which the actual objectives of education are set. These form the scientific preoccupation of pedagogy.

Education can not be reduced to a simple transfer of socio-cultural knowledge and experiences from adult generations to younger generations. It is necessary that this transfer - always fast, abridged and focused - is accompanied by a formative striving (nisus formativus) towards the authentic values, brought together in the educational ideal. For cultural pedagogy, central values are the truth, the good, the beauty and the feeling of the sacred.

Historical outline of the educational ideal

1. For the ancient Greeks - Truth, Good, Beautiful - reunited in the classical concept of Kalokagathia - beautiful body, good soul and a spirit oriented to the search for truth.

2. The educational ideal of ancient Rome - "Mens sana in corpora sano " - being, as a matter of fact, all that Roman culture meant almost entirely a takeover of the Greek ideal.

3. The Middle Ages proposes two types of desirable personality, two educational ideals embodied in monk (monk) and knight.

4. The Renaissance comes as a return to the classical ideal of the Greeks; Uomo universalis is the full, harmoniously developed man.

5. Modernity - the man with the sense of risk and responsibility, the discoverer, the entrepreneur; the modern age adopts classical values (truth, good, beautiful, spirit of the sacred) along with so-called social values: freedom, equality, fraternity, the French Revolution, legality through the Cromwell and American Revolution. All these values define the educational ideal of modernity.

The personal cultural ideal develops through education, uninterrupted contact with culture, is an effect of this contact. The individual is not only formed through school, through the specialized educational institution. He is, from his birth, at the crossroads of different and even contradictory formative influences: family, socio-cultural proximity, cultural and information institutions, etc. On the other hand, great merit of human nature is unrepeatability. People are different from all points of view. These differences should not be abolished through education but, on the contrary, encouraged through an educational offer as varied as possible.

Because the characteristic of the personal ideal is its enormous diversity, it is clear that the educational ideal, with all its normative firmness, must be sufficiently general and flexible, not to contradict the enormous variety of personal ideals.

No community can survive without a well-articulated educational system according to an educational ideal that satisfies the common requirements, without placing the individual ones in brackets. To solve the problem of the relationship between the ideal of education and the personal cultural ideals is to begin to truly solve the socio-cultural aspect of society at a given time. Otherwise, we will continue to maintain and introduce institutions that will remain "forms without substance" and we will still wonder that almost nothing fails to function optimally. It is absurd to believe that we will succeed in making the free economy and democracy functional, without changing mentalities.

It is equally absurd to think that they can be changed without changing the education system. And this must be changed from the "top", from the educational ideal, from the reformulation of a coherent ideal with the way we are looking for our community, therefore synchronous with the one that works in modern societies.

In formulating an educational ideal, not only education experts, but also policy makers, system beneficiaries, cultural institutions, expert groups, interests, or pressure should be involved. At the level of society, of the macro system, the problem of the educational ideal is a policy issue of education and learning.

Along with science and democracy, modernity has made education one of the main resources of development. With respect to the educational ideal, modernity has preserved the values of Greek-Christian humanism, discovered so-called social values, widening the circle of fundamental values to eight: Good, Truth, Beautiful, Spirit of the Sacred, Freedom, Equality, Fraternity, Legality.

4. THE IDEAL OF MODERN EDUCATION

Modernity has thus revealed the axiological framework through which we can think of education as a human being, which is considered to be the subject of education, not a mere object subjected to the processing by an external will - whether this will an educational system, an agent, culture in general.

The feeling of belonging to the European system of values, to the European Community, does not exclude membership of a more limited community that defines us before we realize that we are Europeans. In fact, pedagogy needs to understand how the values (both fundamental and associated ones) translate into educational goals. It is not indifferent whether we are adepts to permanent education or education limited in time, if we are the promoters of a rigidly separated discipline education, or, on the contrary, if we try to propose synthesis and interdisciplinarity.

In the traditional Romanian education, the asymmetry between the results obtained in the cognitive field and the more modest results obtained in the affective and the psychomotor field is striking. The information itself is virtually of no value to the subject of education if it is not annoyed to judge, interpret and use it in a context different from that of primary education. That is why the educational, formative and operational side of the learning systems should be emphasized. We can not but emphasize the need for the educator, the trainer, to regain the cultural model he once held. Like a physician, psychologist, priest or artist, the teacher can not be a mere clerk, but a man who knows he has a vocation and a mission. To be a true and radiant cultural model, the educator must identify himself with the cultural-educational ideal and live in the values of it. For him, the fundamental values of humanity must really exist. If it is not able to do this identification and this type of experience, then it is better to withdraw and move to another field of activity, but not to the formation of people.

A reform of education must begin with the definition of an educational ideal, radically different from that of a man-machine, which in fact constituted - even if never confessed or recognized as such - the guiding idea of the old (and unfortunately still existing) system.

In this context, there is a problem that proves to be the most difficult to solve - that of staffing to move real reform. It is necessary to re-fund the specialized institutions for the research of education, as well as an intensive "recycling" of the teaching staff, which amounts to more than a quarter of a million teachers in Romania. There is no question of changing them - it would be temporally impossible, costly and, of course, inhuman.

But what can be done is changing their mentality through an activity that does not have anything to do with the routine of formal, "lacking" actual and effective content.

These teachers are the trainers of future generations, others can not yet have; but neither with their current level of training nor with their current profile will we be able to reach the desired future. In order to guide young people towards open horizons, they must first open their horizons, they must be created the conditions that allow them to enjoy and enjoy another level of their becoming as soon as possible professional and human.

Only a trainer with decent values and decent motivations, deeply assumed, can try and succeed in building, developing and perfecting a human being in the true sense of the word. Otherwise, it risks contributing to the bringing into the world of either an inert and null individual, or, more seriously, of an individual broken by humanity or seated against it.

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VIRTUAL AUTISM AND ITS EFFECTS ON THE CHILD'S EVOLUTION

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Abstract:*The extremely diverse incidence and symptomatology of autism generates constant concerns among specialists, mobilizes parents and community-based institutions, provokes disputes and controversies within schools when discussing the integration of children with autism into ordinary school environments.*

The Internet is playing an increasing role in education as students have the opportunity to solve the themes and to draft the papers through network transfer, and the opportunities opened up by developing huge libraries with information are important, especially for certain study objects and themes, useful for students. In addition, computer games become the most sensitive subjects of conversation between children, thus helping to establish interpersonal relationships. Another problem faced by children in need is the inability to learn. With a low motivation, unable to concentrate, with excessive hyperactivity, children are increasingly responding to school requirements. Imbalances that viewing induces in the operation of the left hemisphere and lack of normal neural network development affect logical and analytical thinking, syntax building, and discursivity.

Keywords*: virtual autism, stereotypes, repetitive behavior.*

1. AUTISM - THEORETICAL MILESTONES

The Autistic Legend says that the fairies abduct the babies of people from their cribs and replace them with children of fairies that are particularly beautiful, but do not really live in this world, but thinking of the other realm, thus explaining the precarious adaptation to environment and communication problems.

Autism is one of the enigmas that have long become the big challenge but, at the same time, the great problem of many parents, educators, specialists in pedagogy, psychology, medicine. Practical experience has identified a particular category of children with difficulties in communication and relationship with others, emotional instability, whether or not associated with intellectual deficits, stereotyped and repetitive behavior, relevant to the normal educational and social activities of these children.

Autism, with its forms, has become a reality for our society. Extremely diversified incidence and symptoms generate heated discussions, but also constant concerns among specialists, mobilize parents and community-based institutions, provoke disputes and controversies across schools when discussing the integration of children with autism into ordinary school environments.

How autism is defined will influence how it is approached, how the child is treated, how others around will perceive it.

The autistic child is isolated in his own thoughts, without the ability to communicate or to relate himself to anyone, whoever they might be. The autistic child creates a world of his own and is hiding under a hermetic envelope, which isolates him from the outside, preferring the world of illusion and security.

All definitions have only partially captured autism, which continues to lead to many confusions. Autism is "a continuum, a thorny complexity of varied and chained manifestations. It goes from a very serious extreme, where the child remains non-verbal, to the, rare, exceptional extreme, where we meet bright scientists and engineers, musicians and painters "(Peeters, 2016, 148).

2. VIRTUAL AUTISM-GENERAL PRESENTATION

New clinical case studies have found that many children who spend a lot of time in front of phone, computer, television or tablet screens may develop a new type of autistic spectrum disorder: virtual autism. The term was invented by a Romanian clinical psychologist. "I called it autism because it has the specific symptoms of children with autism, perfectly identical symptoms. It is almost impossible to make differential diagnosis if it has or does not have virtual autism or classic autism, because the symptoms are perfectly the same. Symptoms of autism include lack of social reciprocity, lack of visual contact, lack of language development, lack of play and especially social play, a role in which the child pretends to be something or something and stereotypical and repetitive games "(Marius Zamfir).

In the case of children who are considered autist because of watching TV, tablet or cell phone, there is a proper lack of development of the neurological system, due to lack of psychic, motor, sensory, affective and psychosocial stimulation. So in this case it is not about the destruction of neurological links, but about their inexistence or a reformatation of these links, due to inadequate stimulation.

Most of the time, the child receives only certain sensations (visual and / or auditory) from a virtual environment, and can not correlate these visual and auditory sensations with other types of sensations: vestibular, tactile, odor, tasteless, unable to develop accordingly. In such a child, if they do not intervene early (before 2-3 years), these problems will become more and more acute, breaks between sensations and perceptions, accentuating behaviors in the autistic spectrum, they are becoming more and more difficult, and with higher costs.

A study by the Autism Center for Children with Autism in Romania shows that 90% of children aged 2-3 years who are diagnosed with autism are the trigger factor of over-watching television programs or other forms of reality virtual.

Virtual autism - theories

The child in front of the screen does not have the usual language experience, the dialogic stimulation of thought and reflection that parents, grandparents or the human environment generally offers. The visual and auditory stimuli perceived in front of the small screen are so aggressive, they succeed with such rapidity that they exceed the brain's ability to control them. The invariable effect will be the inhibition of some important mental processes. Children get used to watching television or monitors no longer wanting to understand what's happening in the world around them, they're just happy with the sensations. The experience of viewing and accessing virtual environments is not one of real space and time, of real distances and durations, but of virtual, suggested or only stimulated within this world.

The child lacks knowledge by touching and physically manipulating the materials, one of the conditions for conducting the process of knowledge and hence structuring neural pathways. Through television, the little ones are deprived of the silence and respite needed to develop the mechanisms of internal language and reflexive thinking.

The virtual environment not only does not favor an interactive participation in the process of knowledge but, on the contrary, involves a passive experience for the human mind. After prolonged viewing, children will tend to remain in the same state of passivity or non-involvement in the knowledge of the real world. Those who watch TV, "their ability to imagine games is proportional, their mental dynamics weakens." (Virgiliu Gheorghe, 2008, 67).

Since neuronal systems are being set up, connections are made in response to the effort of mental activity, introducing children to the TV environment, familiarizing them with the pleasure of viewing, is to put them at real risk of developing mental abilities.

The brain, like the whole body, needs to feed itself to develop normally. The brain's nutrition, especially in the early years of life, but not only, are stimuli to the external environment, received through the organs of sense but also by movement. Child development stage 0-2 years is called the stage of sensory-motor development. At this stage, the child reacts reflexively in activities such as sucking, hitting, grabbing. It begins to coordinate the visual, auditory and tactile information it receives from the environment (through sensations) with the motor skills it is developing. At this stage he finds that if he moves his eyes, he has access to several images and may even notice how his own hands and feet interact with various objects. In this way, he becomes increasingly aware of the existence of an external environment and his ability to act on this environment.

The first contact of the child with the external environment is achieved through sensations, which are received through the organs of sense, which at birth, even if developed, differ greatly from those of the adult. In contact with the environment, with the passage of time and experiencing new situations, these sensations are transformed into perceptions.

In the case of autism, a multitude of problem behaviors arise: lack of expressive language (speech) or even lack of receptive language (understanding); they give the impression that they do not hear or are overly disturbed by certain noises; eating a very limited range of foods or just certain food textures; they stare at the objects with their eyes on one side; are very attracted to stereotypical or repetitive behaviors; they touch in a very different way certain objects, and such examples can continue.

As a form of relationship life, the psyche reveals its nature through its relationships with: physical reality, physiological reality, social reality. Only in relation to these realities a person builds their own interiority, in the absence of such relations with the environment, the psychic life can be seriously disturbed. This is demonstrated by the experiments of isolation and sensory deprivation (Donald O. Hebb, 1947) and experiments on the behavioral consequences of the social contact deficit (Harry Harlow, 1960). In Hebb's studies, after 20 hours of sensory deprivation, subjects exhibited emotional disturbances, hallucinations, decreased intellectual performance.

The relations of the psyche with its material substrate, with the objects of the material and social world, represent both the framework of the formation and development of the psyche and the instrument of such training.

During the access to the virtual environment, the child receives only visual and auditory information, which he can not process due to his or her young age and which is not integrated with other sensations and perceptions (touch, smell, taste, vestibular sense).

The affective relationship between parents and child is influenced by the availability and empathy the parent exerts over the child's needs. It develops gradually, especially during the age of the child 0-2 years.

Infant attachment has a secure or non-security role in configuring personality and human behavior. The child was born with a propensity to attach to the caregiver, conduct his or her own behavior to maintain crucial attachment relationships for his human and psychological survival, near the caregiver.

Behavioral and behavioral distortions are the source of attachment disorders in early childhood, and can be considered the result of parents' inability to respond to the needs of child comfort, security and emotional confidence, especially in the 0-2 year period.

The intellectual-emotional development of the child is a complex process, the successive stages of which are closely interdependent and are controlled and influenced by genetic and non-genetic factors. After a long time in which the role of genetic factors in the development process has come to the attention of researchers, studies published since the 1990s have given due weight to non-genetic factors related to the child's development environment.

The consequence of this relatively recent trend is that the irreversible effects on child development of deprivation of parental affection and growth in a deviant environment brought to the attention of the scientific world in the 50s by the Bowlby and Ainsworth studies have become the object of the interest of specialists. Today, studying the organic mechanisms through which early childhood experiences shape the development and maturation of the child's nervous system is considered essential for understanding both normal and pathological development.

Bruno Bettelheim (1967) invokes for the first time, as a cause of autism, the parent-child relationship, based on the observation of cooler relationships of the parents with autistic children. These lead to psychological dysfunctions manifested by anomalies of the development of the emotional state of the cognitive sphere, when the difficulties of using the symbols become dominant in language disorders, abnormalities of perceptual and attentional abilities, difficulties in imitation of bodily actions and others. Although these studies have been very controversial and later in the 1980s, it would seem that there is a close link between the level of affectivity offered by parents and the psychosocial development of the child. Thus, any time that is not used for social and affective relations with the child, leads to a delay in its psycho-social and psycho-emotional development.

3. THE EFFECTS OF THE VIRTUAL ENVIRONMENT ON CHILD DEVELOPMENT

The world in which we live can be called an information society; it is in constant change, the computer, with everything it involves, influencing our existence every day. As far as the effects of the virtual environment on children are concerned, there are both positive and negative aspects.

It is known that education in our country predominates the informative aspect in the detriment of the formative one. Thus, the introduction of computer technologies in the school environment has had the effect of increasing the formative aspect by teaching children with an ordered, logical thinking, or, in other words, the formation of algorithmic thinking.

The Internet plays an increasing role in education, as students have the opportunity to solve themes and to draft reports through network transfer. Moreover, the opportunities that open up by developing huge libraries with information, especially for certain study objects and themes, useful for pupils, are important. The board, book, chalk, and notebook have been the classic tools of school education for centuries.

Today, the use of computer in learning allows each child to progress in study according to their ability to assimilate knowledge, avoiding the danger of being braked by a collective under its possibilities or, on the contrary, always being forgotten in the class queue and ignored because can keep the same pace.

In addition, computer games become the most sensitive subjects of conversation between children, thus helping to establish interpersonal relationships. The screens are so appealing that it is difficult for the child to come back to something else. He becomes distracted by the screen and dependent on it. The screen isolates the child from the human interactions that are required for the language communication and development skills. Also, the noise and light on the screens can generate painful emotions the child can not cope with. These feelings can lead to violent and aggressive behavior in the child.

Another problem faced by children in need is the inability to learn. With a low motivation, unable to concentrate, with excessive hyperactivity, children are increasingly responding to school requirements. Imbalances that viewing induces in the operation of the left hemisphere and lack of normal neural network development affect logical and analytical thinking, syntax building, and discursivity.

Suggestions for limiting the time spent by children in the "virtual environment".

To limit the time spent by the child in front of the TV, tablet, computer, mobile phone, parents should adhere to certain rules:

• Make a daily schedule to follow with the child.

• Establish rules for the use of the TV, the computer, and the phone by the child

• Remove any gadget from the child's visual contact.

• Offering rewards when the child respects the daily schedule.

• Building a special place in the house with exciting things that can be used when the child gets bored and wishes to play on the tablet. So the focus will be on something new.

• The TV and the computer will be closed while homework is being done.

• TV shows, computer games will be chosen with discernment.

• Physical activities, walking will be of great significance. Physical activities have a major impact on the emotional development of the child.

Emotional health is very important for the development of the child and can be greatly stimulated by movement. With the help of sport, the child grows physically, mentally and emotionally fulfilled. Sport stimulates interactions. With the help of it, children will learn to be patient with others, to wait for their turn, to be responsible, to respect for others, to be accountable, to cope with unexpected situations, to adapt more easily. And last but not least, they will make friends of the same age with them and with similar passions.

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LEADERSHIP – SPIRITUAL EVOLUTION – INTUITION

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Abstract: *Leaders use the outer world to access a feeling inside themselves. This is why, when getting trained, leaders should start by discovering their inner resource, their leadership and their capacity to change the outer reality according to their own views, the realism of their own perception, their capacity to become aware of and to influence their fears and, last but not least, their desire to act appropriately/morally.*

Keywords: *leadership/ brain polarities/ mental balance/ awareness/ motivation/ mental development algorithm …*

1. MENTAL BALANCE OF LEADERS

There is a saying in the Vedic philosophy, i.e. "World happiness is like a bone to a dog". The dog finds a bone and starts chewing it. While doing this, bone chips enter its gums and it starts bleeding. The dog feels the taste of blood and thinks: "What a delicious bone!" The longer it chews on the bone, the more its gums bleed. The more intense the taste of blood, the happier the dog.

Authentic leaders are happy people because they have discovered their inner source and they have directed their consciousness towards themselves, thus freeing themselves of the paradox learned in school, i.e. searching for answers and confirmation from the outside.

Leadership represents an exercise for leaders to free themselves from their strings and dependencies, their need for approval and appreciation. The majority of people fail to live their lives because, while constantly searching for personal safety, they start to believe that living means staying alive and nothing more. Such people might never find out that life is rather a dance with death. However, there are a small number of people (called leaders) that have that capacity that is necessary in the field of management, i.e. leadership, that helps them overcome their fears by becoming aware of them and by enjoying "the flow" and by focusing on knowing themselves as they go through life, by making time for meditation, nature, music, reading and fellow creatures and by giving up as much as possible of what makes them dependent on what exists outside themselves, i.e. fame, power, attention and wealth.

The leaders, mentally balanced individuals, represent the minority that has learned to activate simultaneously the 2 cerebral hemispheres, thus benefiting from all the human mental capacities. This is the reason why, as opposed to the great majority of people, leaders are realistic/logical/rational and use their intuition at the same time, which enables them not to make confusions (they do not protect themselves by projecting) and, therefore, they will not perceive reality as an expression of a personal desire/fear/belief, regardless of how disappointing it may be.

Most people remain prisoners of their undeclared fears and they mistake these fears for an intuition that they fail to acknowledge/access.

Thus, leaders are a minority with evolved mentality, tolerant in accepting their own capabilities, many of which are hiding the fact that they are living in contact with their own intuitive intelligence and they keep quiet about the fact that most of their decisions and actions are "intuitive".

Intuition is the consciousness that occurs in a moment of unity, in which what we feel can become a source of learning and development, which provides a creative perspective of life. Consciousness guides leaders towards accepting responsibility for their own actions and words and, most importantly, towards being receptive to their own will, associated with a solid moral compass (Vanessa Mielczareck, "Inteligența intuitivă de la vis la realitate" *[Intuitive Intelligence - from Dream to Reality]*, Cartea Veche Publishing House, Bucharest, 2014, p.100-102). The leaders' intuition represents the consciousness of non-separation and sense of "membership", which determines them to place themselves in the plan of wholeness. The world is constantly changing and the intuitive intelligence of leaders can change the manner in which people act by creating a link between their unconsciousness and their consciousness. The awakening/awareness of intuition represents, in fact, the expansion of the consciousness. There is no such thing as good or bad intuition. There is only a correct message and intuition is not classified based on the concrete results obtained. Said results are subject to our subjectivity, judgement and actions in reality, as we perceive it. Nevertheless, intuition can guide us with regard to the best decision that we should make. If we choose to ignore it, we realise later on that it has done its duty. Most people place themselves in a magical type of thinking, by deluding themselves through an immature relating to their own intuition, thinking that it will save them from problems, failures, errors and the hardships of life and expecting their intuition to help them avoid any suffering and remain anchored in the idea that life is a long and still river. Intuition is part of any individual's intimate essence, through the qualities/functions of the brain (the neocortex – table no. 1), as stated by the psychologist T. Dethlefsen and doctor R. Dahlke, the authors of the paper "O cale spre sănătate" *[A Path to Good Health], p.* 39-40, 1990.

Table no. 1 The cerebral hemispheres

Left cerebral hemisphere	Right cerebral hemisphere
Sun	Moon
Logic	Perception of the shapes
Speech centre	Global aspect of a phenomenon
Syntax/Grammar	Specific 3D geometric aspects, notions of depth
Speech hemisphere : reading/writing, arithmetic	Archaic forms of language, music, image, smell
Connection with the environment	Global vision of the world
Digital thinking	Analogical thinking
Linear thinking	Iconography
Left cerebral hemisphere	Right cerebral hemisphere
Sequential aspect, (dependence on the time that passes)	Quality of being new (time)
Analytics	Holistic perception
Rational intelligence	Intuition
Yang	Yin
Male	Female
Human consciousness	Human unconsciousness
Activity	Passivity
Electricity	Magnetism
Right side of the body	Left side of the body
Right arm	Left arm

Choosing to do or not to do something cannot be excused by intuition. As balanced people, leaders use their intuition in all their endeavours, which enables them to hold the creative power, starting by being in charge of their own lives, being aware and in control of their own personal feelings. We generally use one of the two cerebral hemispheres as a dominant function, but by learning to simultaneously activate both hemispheres we can achieve mental balance and an efficient use of all of our mental capacities.

Intuition has the role of enabling good communication with our fellow creatures, by instilling a state of mental acuity that makes us relate to a "tuning fork" when we are in somebody's presence. We relate our personal frequency to that of our interlocutor in order to get a better understanding of what animates that person or about their physical and mental state. By doing this, we have the availability to receive information and messages from our interlocutor. Thus, we can get this kind of information in order to find the best means to express what we wish to communicate. By being in a true state of listening (active and empathic), we will be able to adjust the discourse in such a way that our interlocutor will be able to understand it (figure no. 1). There are various types of listening:

•Active ignorance (we hear nothing from what the interlocutor says, as he/she is paid not attention to).

•Simulated listening (during social events we talk to the interlocutor while scanning the room to find another person, having no idea about what the interlocutor is actually saying and we smile politely).

•Selective listening (we only hear what we want to hear, particularly the messages that strengthen our beliefs).

•Careful listening (we concentrate on the oral message and we ignore the interlocutor's non-verbal communication).

•Empathic listening (we understand what we are listening to and we pay attention in order to identify the interlocutor's desires, reasons and situation, paying attention to both the verbal and the non-verbal communication).

Thus, we develop such qualities as acceptance, respect, empathy and diplomacy. Acceptance means concentration and underlining the similarities between us and the interlocutor (things we agree on and on which we have the same opinions and reactions). This manner of relating to one another will help us overcome antagonism, fear and anger. Respect means showing the interlocutor that we are alike, which can be done unconsciously when you feel sympathy for the interlocutor or consciously as a means of generating solicitude, in case the interlocutor is frustrated and has the tendency to reject us.

PASSIVE LISTENING	ACTIVE LISTENING
- we nod to what the interlocutor is saying and make short comments such as "yes, good" and once s/he has finished her/his speech, we give the interlocutor our opinion; - we interrupt the interlocutor in the middle of the sentence; - we give information to the interlocutor, but we forget to ask what s/he has understood; - the interlocutor is talking by herself/himself, but we are not listening.	- we listen carefully to the interlocutor; - we do not interrupt the interlocutor until s/he has finished the sentence; - we ask questions with regard to the interlocutor's explanations; - we try to listen to the interlocutor and to have the same perception on what s/he is saying; - when we give information we make sure that the interlocutor has accepted it; - we use what the interlocutor is saying in order to present our own ideas.

FIG.1 Active and empathic listening

The paradox of human nature is that the individual wants something, but at the same time, s/he also wants the opposite. Regardless of appearances, all people fight against their own failures, thus strengthening the negative thoughts that they have about what they want to do and struggling against their own desires to evolve and transform themselves. Leaders are the people who, fighting against their own failures, strengthen their positive thoughts about what they want to do and maintain their desires/ideals to evolve and transform themselves.

The term "shadow" belongs to Psychologist Carl Gustav Jung. This concept refers to the human psyche that contains what we can accept about ourselves, as well as what we detest and do not want to see or know about ourselves. What is included in the shadow is not identified, accepted, assimilated or transformed. Starting from an early age we try to escape sorrow by suppressing it (we put everything we are unable to solve during our lives in the shadow area). The leaders represent the minority that are able to overcome sorrow without suppressing it, by accessing their own emotions in ways that diminish the devastating impact thereof.

2. SUCCESSFUL FACTORS IN DIMINISHING THE IMPACT OF EMOTIONAL TRIGGERS

Human beings access their emotions in different manners:

-activation of the automatic evaluators (the instinct of self-preservation) and the automatic evaluation mechanisms; in this case, unconsciousness acts as a database of the emotional warning signs inherited through natural selection (for example the fear of cats in the case of the mice that were born in laboratories);

-reflexive assessment that subsequently activates the automatic evaluators;

-recollection of an emotional experience from the past;

-imagination;

-talking about an emotional event in the past;

-empathy;

-breach of the social norms and voluntary assuming of the occurrence of an emotion.

Motivation represents the advantage of feeling emotions. Fear is the emotion that protects, saves our lives and makes us capable of responding proactively to threaths (Figure 2 explains the point of view of Psychologist Vanessa Mielczareck, which she details in her paper "Inteligența intuitivă" *[Intuitive Intelligence]*, Curtea Veche Publishing House, 2014, p. 199).

Feeling emotions can be inhibited either excesively or in a balanced manner. Table 2 shows fear in the 3 forms in which it can manifest itself and the areas of the brain involved in each of these cases.

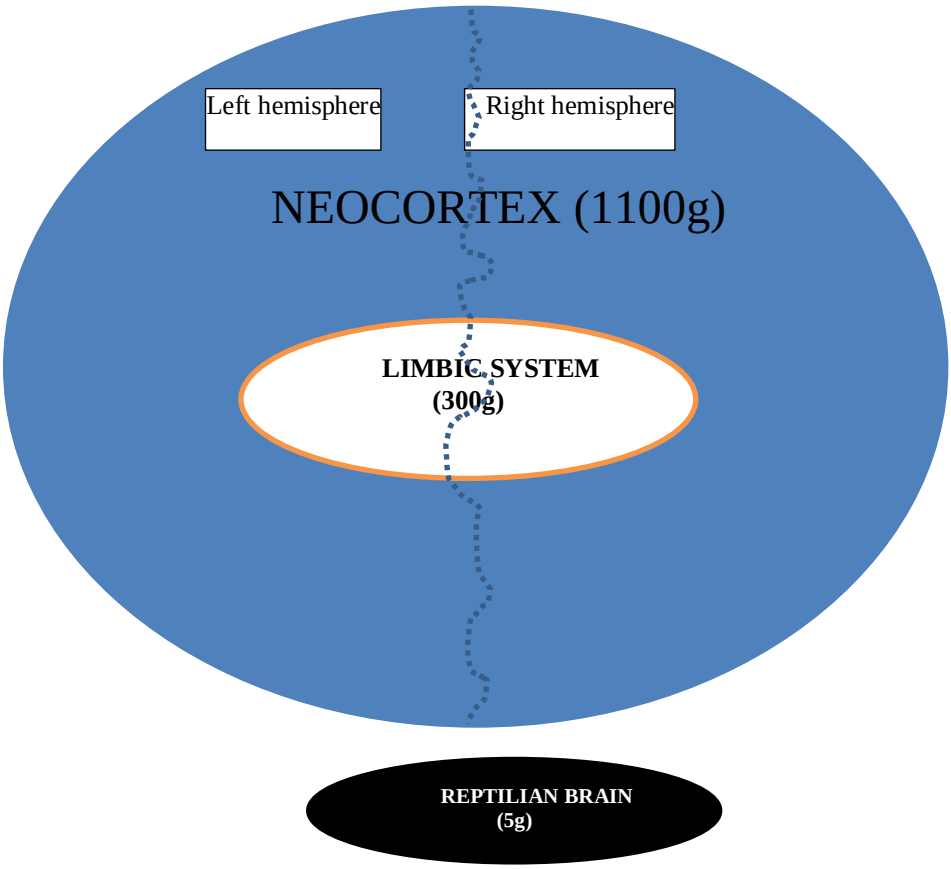


FIG.2 The Brain

Table 2 - Manners in which the individual relates to the fear of death/sorrow

Inhibited fear	Excessive fear	Balance in feeling fear
The reptilian brain and the neocortex are involved	The reptilian brain and the neocortex are involved	The neocortex, **the limbic system** and the reptilian brain are involved
Danger is denied and erroneous perceptions are added	The doubt of being able to survive and the exceptionally terrifying perceptions are added to the danger	The proper channelling of fear to insure survival by means of an appropriate behaviour (fight or run); the
Inhibited fear	Excessive fear	Balance in feeling fear
		limbic system properly guides the functions of the brain.
Usable forms of denying danger : - bravado, - aggressiveness, - self-destructive behaviour, - masochistic behaviour, - imprudence, - irresponsibility.	Exacerbated forms of perceiving the fear of death and suffering: - cowardice, - passivity, - manipulation, - cruelty.	Forms of balanced behaviour in feeling fear: -emotional self-knowledge of what we feel towards positive/negative events, in order to react by properly adapting to the environment. -information flows through neurotransmitters between the left and right hemisphere, by underlining the intuition of an enlightened intelligence.
The issue of inhibiting fear requires consultation of a therapist.	The exacerbated feeling of fear can be resolved by exercising the interior perceptions in order to free oneself through desensitivity.	

Sadness is a beneficial emotion, provided it is accompanied by mental balance, since it is useful in helping us receive help from others. In case of mental unbalance, sadness can be inhibited or exacerbated, thus becoming harmful (Vanessa Mielczareck, 2014), according to table number 3 in which sadness is shown in the 3 forms in which it can manifest itself and the areas of the brain involved in each of these cases.

Table no. 3 Manners in which the individual relates to sadness

Inhibited sadness	Excessive sadness	Balance in feeling sadness
The reptilian brain and the neocortex are involved	The reptilian brain and the neocortex are involved	The neocortex, **the limbic system** and the reptilian brain are involved
The first 3 stages of mourning :	The 4th stage of mourning:	The last stage of mourning :
Inhibited sadness	Excessive sadness	Balance in feeling sadness
- denial, - anger, - negotiation.	- depression	-acceptance, -healing, -metamorphosis.
Specific behaviour: - coldness, - rigidity, - pride, - cruelty, - indifference, - insensitivity.	Specific behaviour: - depression, - apathy, - victimisation, - loss, - discouragement, - weariness.	Specific behaviour: - sensitivity, - acceptance, - compassion, - empathy.
Manners of dealing with inhibited sadness : -to acknowledge sadness *to* ourselves and to our peers; -to stop hiding the sadness ; -to go out in the world and meet with friends; -to learn to detach from what is sad by reading, listening to music etc.; -to do things one passionate about; -to transform pain into spiritual awakening by becoming open to sensitivity and compassion.	The excess of sadness can only be resolved with the help of a therapist.	

The 2nd stage of sadness is anger that motivates us to fight and, if we are mentally balanced, to properly channel our efforts to change the world. In case of mental unbalance, anger can be exacerbated or inhibited and that leads to hatred and irresponsibility (Vanessa Mielczareck, 2014), according to Table 4 in which anger is shown in the three forms under which it can manifest itself and the areas of the brain involved in each of these cases.

Table 4 Manners in which the individual relates to anger

Inhibited anger	Excessive anger	Balance in feeling anger
The reptilian brain and the neocortex are involved	The reptilian brain and the neocortex are involved	The neocortex, **the limbic system** and the reptilian brain are involved
Leads to anger	Is uncontrolable	Is properly channeled
Specific behaviour: - resignation, - melancholy,	Specific behaviour: - despotism,	Specific behaviour: - courage, - will,

Inhibited anger	Excessive anger	Balance in feeling anger
- passivity, - submission, - laziness, - softness, - cowardice.	- autocratism, - irascibility, - aggressiveness, - irresponsibility.	- entrepreneurship, - power, - proper authority.
Manners of dealing with inhibited anger: -to identify the factors that trigger the anger; -to say what you are feeling as soon as you are no longer emotionally charged; -to speak about yourself; -to cultivate interior safety ; -to increase your self-esteem by improving the image you have of yourself; -to accept yourself as you are; -to be honest with yourself; -to not dramatise any situation; -to tell yourself that you are in a process of evolution when you are trying to change your attitude; -to learn to love yourself again; -to do physical exercises; -to do breathing exercises.	Manners of dealing with exacerbated anger : -to defuse yourself by concentrating on another thing; -to be aware of what activates and stimulates you; -to leave the room in order to create a time breake between yourself and the situation/person that is making you angry; -to learn to breath counsciously, slowly and steadily.	

3. EMOTIONAL TRIGGERS

The concept of automatic evaluator that triggers fear is something that occurs suddenly in our visual field, approaching us as if it were trying to hit us (for example, the fear of the beginner driver who is trying to learn how to control it in traffic by practicing driving for a long time). Our emotional system is created to maintain said triggers and not to eliminate them; therefore, we are biologically created in such a way that we cannot easily interrupt these responses.

Herein under are the 6 factors that lead to the successful diminution of the intensity/importance of an emotional trigger and of the duration of the resilience during which we can only use the information that confirms the emotion we feel:

1. Tackling the fear (that is inversely proportional to the difficulty of reducing its emotional impact);
2. How similar is the current triggering event to the original situation in which that trigger has occurred for the first time;
3. How early in life did we learn that trigger (the earlier in life, the harder it is to weaken it: early childhood is a decisive stage in the formation of one's personality and emotional life; the emotional triggers that were learned during the early childhood can lead to a longer duration of resilience to acknowledging them);

The initial emotional charge (the impact of the emotions felt when the trigger was learned is harder to diminish if the initial emotional charge was high);

4. The depth of the experience that contributes to the power and performance of the trigger (the more frequent and emotionally charged the episodes, the bigger the depth and the more overwhelming their effects upon a person);
5. The affective style (the more frequent and powerful the emotional responses given by a person, the harder it is for that person to calm down).

4. CONCLUSION: THE INCREASE OF THE MANAGEMENT PERFORMANCE BEGINS BY CULTIVATING POSITIVE THINKING IN THE RECRUITEMENT/SELECTION/TRAINING OF THE MANAGING STAFF

In order to attain management performance one needs to start by increasing the premise of eliminating restrictive thoughts and replacing them with positive statements that are expected to be put into practice. The human brain has two polarities, i.e. a positive and a negative polarity (Vanessa Mielczareck, 2014, Inteligența intuitivă *[Intuitive intelligence]*, Curtea Veche Publishing House, p. 158). Psychologist Annie Marquer defines the brain hemispheres as follows: "superior" for the positive polarity, marked by "+" and "inferior" for the negative polarity, marked by "-"; however, this does not mean that one is better than the other. Proactively, the superior hemisphere has a higher vibrating level than the inferior, which is associated with automatisms and the concrete reality. In general, we encounter difficulties in integrating the two hemispheres that represent the centre of our mental activities of various types. The left rational side of the brain has often been put in opposition to the right intuitive part of the brain.

The left hemisphere is a computer that makes rational analyses. The right hemisphere is connected to our more profound and subtle levels (the unconsciousness). Together, the two hemispheres give birth to a new reality, i.e. the conscious and the unconscious mind, the dualism of the consciousness that leads to agreement and disagreement.

When the two hemispheres of the brain are in harmony, we are on the effortless path of "flowing and fluency", i.e. balance. When there is a conflict between the two sides of the brain, we will self-sabotage. The right hemisphere (the unconscious mind) sabotages the power of our will (the left hemisphere, the conscious mind) and the comfort zone will be preferred, even if it is not ideal. The unconditional submission/cooperation of the unconsciousness (the right hemisphere as the area of the brain that includes our image of ourselves and our past, including all our unresolved issues and hidden feelings) to/with the consciousness (the left hemisphere) leads to the annulment of the unconscious sabotage mechanisms.

Emotions belong to the sensitive level, while reason belongs to the tough level. When there is no balance between the two hemispheres of the brain, stress occurs. An emotion is an association that we make with a certain sensation. The sensation itself has a predominantly energetic nature, conjugated with electrochemical reactions in the central nervous system (Vanessa Mielczareck, 2014, p. 68). The electrochemical reactions are secondary to the energetic reactions. Every time we feel an emotion, we have an accumulation of energy that needs to be released.

Thus, emotions consist of an energy that needs to be directed somehow, regardless of its cause or stimulus. The stimulus is not important at all; it can be more or less relevant. However, what matters is what we do with this energy. It is never practical to express your emotions. Therefore, we learn to repress them from an early age in order to stay in the pattern that our parents have created for us, by learning to apply the mechanisms of protection of our psyche by denying, rationalising, trivialising/minimising, rejecting and blaming.

However, discipline may be missing during childhood, thus depriving the future adult of his/her most valuable factor of success. "We must teach ourselves and our children the need for suffering and its value, the need to directly confront our problems and to experience with the involved suffering"; this is the opinion of Psychologist Scott Peck in the scientific work "Drumul către tine însuți" *[The Path to your Own Self]* published by Curtea Veche Publishing House in 2013, p.16. He states that discipline represents the fundamental set of tools required to solve the problems of life.

It will become clear that these instruments favour suffering. They are the means through which we feel the pain caused by our problems so that we can successfully overcome and solve them and, in doing so, we learn and we evolve. When we teach ourselves and our children discipline, we learn how to suffer and evolve.

Doctor Peck mentions 4 instruments of discipline:

1. Delaying satisfaction;
2. Accepting responsibility;
3. Devotion to the truth;
4. Balance.

Most inner tensions come from:

-The desire to obtain immediate satisfaction;

-The avoidance of responsibility;

-Self-deceipt and the deceipt of the ones around us;

-The inability to recover from the failures in life.

Each time we are dealing with inner tensions, we must strive to remain connected to our own self by:

-avoiding to return to the childhood survival rules;

-avoiding to adopt the role of the persecuting parent, by criticising ourselves and rejecting our own behaviour or performance;

-avoiding to deprive ourselves of the care and love of ourselves.

Evolution means passing from the first level of consciousness (from matter) to the third level (antimatter); this is the opinion of Psychologist Ray Martina in the scientific work "Echilibrul emoțional" *[Emotional balance]*, published by Curtea Veche Publishing House, 2014, p. 29-31. The three levels of consciousness are presented in Table 5.

As a matter of fact, the two hemispheres of the brain represent the expression of the global mental system and have a so-called "inner" side that is automatic and uncontrollable and a "superior" side that is open to the energy of the soul. If we use the superior side to evolve, we will develop both the qualities of the left hemisphere and those of the right hemisphere. People who are at the beginning of such a process will obtain a higher level of sensitivity (the right hemisphere is active); however, this sensitivity is limited by the insufficient development of the left hemisphere.

The true spiritual development includes all the superior mental functions, not only the "sensitive" and "intuitive" aspects of the right hemisphere. The positive polarity is connected to the self and the interior exercise involves the dissolution of restrictive programming. The development of the left hemisphere can be achieved through any activity that requires concentration and precision (reading, writing, resuming studies in a field that interests us), while the development of the right hemisphere can be achieved by learning to control emotions by means of painting, drawing, collage, claywork, dance, meditation.

The polarities of the brain enable the development of the individual from the inferior consciousness to the superior consciousness by giving up the representation about oneself (ego) and the awareness of the freedom of truly being, by manifesting oneself as "a disciple of the events of one's own life and the master of one's own existence" (self), according to the stages of the mental development algorithm, Figure 3 (the opinion of psychologist Annie Marquier, as presented in the work "La liberté d'etre" *[The Freedom of Being]*, Les Editions Universelles du Versean, 2000, p. 37,59, 513-514).

Table no. 5 Consciousness as a dimension of the human psyche

The structure of consciousness		
Level 1 MATTER Aspects that characterise consciousness at this level:	Level 2 ENERGY Aspects that characterise consciousness that has evolved at this level:	Level 3 ANTIMATTER Aspects that characterise consciousness that has evolved at this level:
To have success you need to work hard and consume a lot of energy. The supreme scope is the material manifestation thereof. It is believed that you are guided by circumstances and that you can be lucky or unlucky.	To have success you need a consciousness that has evolved past the first level and that consists of optimising the price that needs to be paid for success. The supreme scope is efficiency, by listening to feelings and intuition. It is believed that you are guided by the choices that you make based on the courage to follow your own intuition. The individual accepts life with its ups and downs doing what he believes is right according to his intuition. Family and happiness are more important than career. The individual creates synchronicity in his life, communicates with his superior self, understands the language of the universe and practices the delay of immediate satisfaction and balance.	To have success you need to work hard, by applying the path of minimum resistance. The work no longer drains the individual of energy, since he is stimulated and revitalised by the work. The supreme scope is the synchronisation with the universe. It is believed that you are guided to create things instantaneously by attracting the right people at the right time. The individual dedicates herself/himself to others being aware of all the signs sent by the universe. Success comes without any strenuous efforts. What is happening in the individual's life reflects his intentions. The individual's relationships are based on spiritual values, not on conditioned love. The priority of the individual is represented by spiritual evolution; leaving everything that distracts him from it aside and choosing to be pure and clean in his intentions, by devoting himself to truth and balance. There are no ups or down, there is only NOW, which frees the individual from his past.
The structure of consciousness		
Level 1 MATTER Aspects that characterise consciousness at this level:	Level 2 ENERGY Aspects that characterise consciousness that has evolved at this level:	Level 3 ANTIMATTER Aspects that characterise consciousness that has evolved at this level:
		Many people fail to achieve this level of consciousness or are unable to maintain this level. The individual is aware of the fact that he is responsible for all that is happening in his life.

This analysis algorithm leads to awareness by freeing some interior space for positive beliefs to be embedded. In order to significantly improve the results of a technique of positive affirmation, it is necessary to apply the protocol consisting of the following integrative principles of positive assertions (Vanessa Mielczareck, 2014, Inteligența intuitivă *[Intuitive Intelligence]*, Curtea Veche Publishing House, p. 171):

1. The positive assertion will be formulated in the present.
2. It must be something that can be put into practice.
3. We only relate to ourselves for the purpose of being fully involved.
4. The formulation must be extremely precise, without any room for interpretation.
5. Believing in the chance to see the desired changes actually happen in our lives.
6. Complying with the 5 stages for each particular key (negative thought).
7. Checking the extent to which we are willing to make the changes that we desire.

DEVELOPMENT algorithm

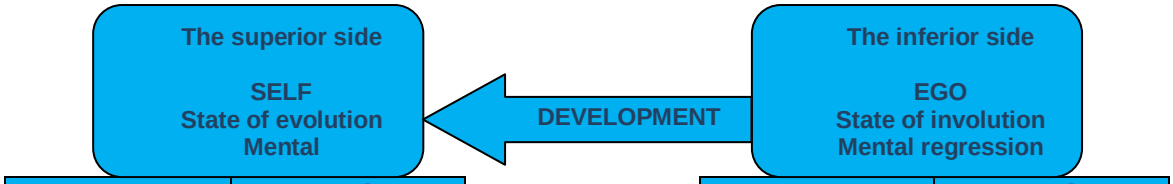
Stage 1: Listing to the negative thoughts that we have.

Stage 2: Writing down the consequences of each of the negative thoughts listed in the first stage.

Stage 3: Writing down what is happening at an emotional level for each of the negative thoughts.

Stage 4: Mentally visualising the manner in which the negative thoughts will influence our life.

Stage 5: Detecting the hidden benefit by uttering the pros of becoming aware of the negative consequences.



LEFT HEMISPHERE	RIGHT HEMISPHERE
Concentration	Intuition
Analysis	Creativity
Self-control	Sensitivity
Will	Love
Integrity	Empathy
Ability to act	Inspiration

LEFT HEMISPHERE	RIGHT HEMISPHERE
Rigidity	Illusion
Manipulation	Laziness
Pride	Instability
Stubbornness	Disorganisation
Lie	Lack of reason
Lack of sensitivity	Avoidance

FIG. 3 The polarities of the brain in the development process through the algorithm of mental development

We are only vulnerable to the extent to which we identify ourselves with the mechanisms of the ego. If we do not want to be manipulated, it is enough to free ourselves from these mechanisms and to change the level of consciousness. If we try not to control everything and to free ourselves from the hold of our ego, we will be free and in contact with the true needs of our being and nobody will be able to manipulate us (Annie Madquier, 2000).

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LEADERSHIP – THE STRATEGY OF CONFIDENCE IN LIFE – THE ECOLOGY OF LOVE

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Abstract: *Everything in life is constantly in some sort of relationship. Each person and each situation that one encounters helps create that person by shaping them and by bringing the unique traits of their being into light. It is also true that the relationships we establish with the occurring circumstances can also entirely inhibit or supress other innate qualities that form the fundamental traits of our nature.*

Keywords: *leadership/ survival/ real self/ false self/ awareness …*

1. THE PROPER RELATIONSHIP WITH ONE'S SELF

The atoms, the galaxies... everything is moving in the complex and miraculous dance of relationships. This is also the case of human beings. People cannot exist without defining themselves through relationships, without gaining interest in the same way or without getting into a real relationship with other fellows. It is for this reason that throughout our lives, the relationships that we establish are the most important means through which we deepen the knowledge about ourselves. Neither of us has the power/authority to control what could happen to us as a result of the influence of others, by means of their attitude, words or actions. Our only real power is represented by our contribution to the relationships that we establish with our peers and this depends solely on the beginning of the manifestation of our contribution. If we begin with a feeling of uncertainty, there is a real possibility for us to be left without any trust and full of needs. However, if we begin with a feeling of plenitude, there is a real possibility for us to be generous and forgiving. The emotional tone of all the relationships that we establish throughout our lives is invariably marked by the quality of the relationship we have with ourselves at that time.

The effort of finding the optimal path that we could follow in establishing relationships with our peers involves assuming the obligation to love others in the same way that we love ourselves and to treat others in the same way that we wish they would treat us (the golden rule). The problem here is that we often fail to love ourselves or we treat ourselves in a horrible way, by setting goals that are impossible to attain, by telling ourselves that we would be someone else if we could and that we are unattractive, by pushing ourselves to the maximum point of exhaustion and forcing ourselves mercilessly beyond the physical limits of our tired bodies, by punishing ourselves for every missed chance, every failure and every omission. Under these circumstances, how could we behave nicely with others and how could we expect them to behave nicely with us?

In our relationships we seek to perform the mimetic immitation of the early emotional environment of our lives.[1]

Even when we are raised in a happier environment, we develop our self-awareness independently from our will, which unavoidably involves a manner of response to the support provided to us by our parents and a confusing jumble of personal needs and fears.

Under these circumstances it is possible for each of us to be uncertain of who we truly are and what our true needs are; therefore, by trying to create love around us, we end up creating suffering in the relationships with our peers. Early in life our psychology betrays us through the manner in which we engage in interpersonal relationships, which only partially expresses our true self. The relationships that we engage in represent manifestations of the point at which we lost contact with ourselves. The quality of the relationships that we establish with our peers depends on how close or far from our true selves we live. The result of the actual relationship represents an indication of the starting point in the manner in which we are going to relate to a peer in the future. We can decide that this starting point can be an internal feeling of certainty or uncertainty, of enthusiasm or, on the contrary, of cynicism. We are usually able to determine what this starting point is, but the results of our relationships with our peers will provide us with an answer regarding how close/far we are from our true selves.

2. SELF-PERFECTING OF THE SELF

We see the world through the prism of our own manner of perceiving our self and our level of self-perfecting this self depends mostly on what we bring into our relationships with the others, the manner in which we perceive them and the manner in which we interpret their words and actions. This is why, in order to properly apply "the golden rule", i.e. "treat the others as you wish to be treated" or the 2nd commandment of the New Testament, i.e. "You shall love your neighbour as yourself", it is necessary to understand them by starting to "know yourself and love yourself".

When we bring something truly authentic and innate, that comes entirely from within us to our relationships, regardless of how vulnerable it makes us feel, we create a transformational, even sacred atmosphere that increases the knowledge that we have of ourselves, in manners that help us heal old wounds, since it also blesses us with a great awareness of what we truly are. This is the environment that supports the true self, that complies with our unique character and that teaches us to trust ourselves and to open ourselves to life, while we are invaded by a general state of wellbeing in the relationships with ourselves and with our peers (faith, trust, love). At the opposite pole, there are the relationships in which we bring a distorted image of ourselves that is full of biased tendencies based on the ideas of others about what we should be in order to survive in good conditions, in manners that develop a false (idealised) image of the self, one that is extremely sensitive and attentive to the imminence of criticism and profoundly marked by the feeling that we are not accomplished enough, that we are not well enough positioned and that we are not safe enough in order not to be exposed as impostors. This feeling of insufficiency becomes the basis of our identity and makes it harder for us to clearly position ourselves in relation to our own sensations, feeling and thoughts, by distorting our capacity to perceive the surrounding environment so as to get to protect ourselves by projecting our uncertainty upon the world in general.

3. THE FALSE SELF OR THE IDEAL SELF

How many people will make their true self disappear in order to be loved, successful, accepted and to feel powerful and safe, and that not owing to their fundamental nature, but because they have adapted to the requirements of their peers?

How many of these people will not end up as a product of the disintegration caused by the cultural norms, living their lives in poverty, deprived of their rights or estrangement?

How come, even though we are born with this preoccupation for survival, the ideals of our culture represent pure ambition and the accumulation of wealth as goals that are opposite to the spiritual evolution, since they condemn the individual to walking a path that is constantly marked by stress and to the inability to get to the core of the problem and to heal it, namely that unconscious feeling of insufficiency that they suffer from? This system of inner attitudes has been cultivated by the representatives of authority (parents, teachers, bosses) by means of direct and indirect indoctrination.

Direct indoctrination occurs within the family, church and school, where we are explicitly told who we are, what life means and how we should behave, whereas indirect indoctrination represents the subconscious process of retention of everything we notice to be strongly accentuated or demonstrated by our parents while we are very young. We are instantaneous barometers in the deterioration of emotional hypocrisy. When our parents say and do something, but our perception is that they mean something entirely different, this confuses and disturbs us inside. In time, such hypocrisy will threaten the complete development of the self, since we start to devise our own strategies of psychological safety in order to protect ourselves, without being aware of what we are doing, but quickly deducing what is valuable to our parents and what leads to their approval/disapproval. We quickly learn which of our traits make our parents respond in a way that makes us feel loved or ignored, valuable or useless, worthless. We learn to adapt by means of acceptance, defiance or retreat. [2]

It is only during early childhood that we do not approach the reality of the world through the prism of our parents' tendencies and preconceptions of what is good or bad, but we express our true self in a spontaneous and natural manner. We become aware of the early power of this self only in the general context of the fears, hopes, wounds, convictions and resentment of our parents, their elements of control and their manner of acomplishing the act of nourishing, either through love or through suffocation or neglect. This process of socialisation is as old as the history of mankind. For our parents we are invisible as unique individualities when they look at us through the lenses of their own manners of adapting to the vicissitudes of life; we learn to become visible to the representatives of authority by becoming anything that might help us obtain more comfort or the least discomfort possible, thus getting shaped as survivors in this emotional climate and assuming a false personality, in order to maintain an acceptable bond with the people that we need to satisfy our need for attention, growth, care, acceptance and protection.

4. CONCLUSION: STRATEGIES OF SURVIVAL THROUGH ACCEPTANCE, DEFIANCE, RETREAT AND THE RESULT THEREOF: THE EGO AND THE UNTRUE SELF

Acceptance represents the adaptation strategy that children learn once they understand that:

- the acceptance of the requirements induces the best response from the others;
- being kind and making yourself likable give you the greatest chance for emotional survival.

This adaptation strategy belongs to those for whom maturity will mean diplomacy, making themselves likable to others, being capable of fulfilling the needs of others, seeing greater virtues in the loyalty to their peers than the satisfaction of their own needs.

Defiance is another strategy used to diminish discomfort and win the attention of others when the individuals have a strong combative spirit and build their identities by pushing aside the personalities of their parents. The fight for autonomy can make them incapable of accepting any authority at a later stage, or it can make them constantly need a state of conflict in order to feel alive.

Retreat is a strategy that seems to work when children become introverted, by choosing to detach and escape to imaginary worlds. This method of adaptation for survival can make them live so immersed in their own convictions that they become incapable of finding room for their peers, in order to get to know them or to become emotionally affected by them.

In each of the three strategies of adaptation, survival determines the development of the ego (the untrue or false self) by renouncing the real self. Each of these three strategies tries to create a version of the life that the individual is convinced s/he should be living, but by doing so, s/he fails to experience her/his life at its fullest, even though s/he is alive, because s/he is currently unable to fully control the situations that s/he must face throughout her/his existence that is interconnected with everything around her/him. The survival personality has the role of maintaining alive identities that have deep roots in escaping from threats, which is characteristic of early childhood. Threats occur due to the difference between the manner in which we perceive ourselves during the early childhood and what we later learn to become as a response to our parents' expectations and their reflexion within us, as their children, i.e. the discrepancy between the ideal self and the true self. From a psychological point of view, we could say that the maternal aspects (related to the manner in which the mother holds her child at the chest, the manner in which she caresses him/her, the tone of her voice, the way she watches the child, how calm she is, the manner in which she calms down the spontaneous manifestations of her child, the support and respect that she offers her child etc.) cultivate the initial perception of the self of the later to be a grown-up and if these aspects are allowed to surface during the individual's life, they strongly influence the manner in which s/he will cope later on, when s/he faces negative, painful, emotional aspects.

On a different note, the elements that remind us of the paternal side of the relationship, that refer to the perception of the world beyond the family home (how tired the father is when he arrives home, if he is upset, depressed, satisfied or full of enthusiasm, how he speaks about the world outside the family, the decree to which he describes the world as being threatening, unfair, dangerous) cultivate the sense of the adult's general perception of the world, but also her/his degree/capacity to face the inherent challenges of life, by implementing views of the world.

Our parents' capacity to support our process of discovery and to reflect our attempts in a manner that is neither excessively protective, nor characterised by neglect, depends on their own consciousness. Each individual changes his early manner of understanding his traits, based on the emotional and psychological ground of his parents, in the same way the iron fillings spread over a sheet of paper align themselves in a certain manner that is determined by a magnet held underneath [2] Even in the most loving family environments, the child can lose the spontaneity/authenticity of her/his self to a significant degree, without being aware of this or without his genitors being aware of this. As a result, a feeling of anxiety occurs inside the child's soul, without her/him being aware of it, which, during adulthood, s/he will begin to feel under the form of ambiguity in the close relationships with the peers.

In order to compensate for the feeling of insufficiency, of unworthiness of being loved and worthlessness, the adult devises a combat strategy called "the ideal/false self", by means of her/his public image.

Our parents' capacity to support/encourage us to express our true self depends on the extent to which they manifest the authenticity of their own self. If the parents live in a world full of false and idealised forms of their selves (they are dominated by the ego, be it egotistical or depressive), they fail to acknowledge the fact that they project onto their children some expectations that are insufficiently analysed, which they themselves had been obligated to fulfil when they were young. Under these circumstances, they will be unable to appreciate the spontaneous nature and the authenticity of their children and they will not let it remain intact. Instead of changing themselves, these parents try to change (by believing that they are educating) their children, by determining them to give up and forget their fundamental nature, their true self and to adhere to the surviving personality, an image of themselves that, even though false, is in accordance with the surviving ideal, i.e. material wealth, social status, perfection, the idea of coming out first, regardless of the competition. As long as we protect the image of ourselves (our idealised self) we will condemn ourselves to imagine the existence of certain ideal, perfect relationships that are as unreal as our selves. What is certain is the possibility to begin to establish mature bonds that will truly fulfil us and heal us from a psychological point of view.

5. THE STUDENT TEST (T) FOR THE COMPARISON OF THE ENVIRONMENTS OF TWO PAIR LOTS

The aim of the test: To observe the capacity to love of two pair lots (young persons and adults), each containing 11 subjects. A projective test was applied, i.e. "The four doors test" (author and psychotherapist Alina Blăgoi; http://alinablăgoi.ro/4uşi-psihologic/).

Conditions of conducting: for each observation in the adult lot there is a corresponding observation in the youth lot and the differences between the pair values are distributed normally.

Null hypothesis: the average of the differences between the pair values of the pair lots is not significantly different from zero, i.e. there are no differences between the capacity to love of young people and that of adults.

Alternative hypothesis for the bilateral test: the average of the differences between the pair values of the pair lots is significantly different from zero, i.e. there are significant differences between the capacity to love of young people and that of adults, which means that an important side to the evolution of the human beings is their capacity to love unconditionally, (Table no. 1).

Table no. 1 Capacity to love unconditionally of young people and that of adults

ID	Choices in the adults' lot	Choices in the young people's lot	Deviation (d)
1	9	4	5
2	7	7	2
3	9	1	8
4	2	1	1
5	7	2	5
6	7	5	2
7	3	4	-1
8	9	3	6
9	7	4	3
10	3	4	1
11	2	4	2

Number of degrees of freedom (df): $df = \mathrm{n} - 1$ = 11-1=10

The significant threshold is (α): α=0.05

By observing the table of the Student Test for the degrees of freedom 11-1=10, at the freedom threshold of 0.02 we find that T critical is $t_{10\,\frac{0,05}{2}}$ = 2.228 .

Critical region: $(-\infty; -t_{n-1\,\frac{\alpha}{2}}] \cup [+t_{n-1\,\frac{\alpha}{2}}; +\infty) \rightarrow (-\infty; -t_{10\,\frac{0,05}{2}}] \cup [+t_{10\,\frac{0,05}{2}}; +\infty)$
$\rightarrow (-\infty; -2,228] \cup [2,228; +\infty)$

Average difference ($\bar{d}$) : $\bar{d} = \frac{d_1+d_2+\cdots d_n}{n} = \frac{5+2+8+1+5+2-1+6+3-1-2}{11} = \frac{28}{11} = 2,54$

Standard deviation of differences: $s = \sqrt{\frac{(5-2,54)^2+(2-2,54)^2+(8-2,54)^2+(1-2,54)^2+(5-2,54)^2+(2-2,54)^2+(-1-2,54)^2+(6-2,54)^2+(3-2,54)^2+(-1-2,54)^2+(-2-2,54)^2}{10}} = \sqrt{\frac{3,14}{10}} = \sqrt{0,114} = 0,337$

The volume of each sample (n) : n=11

Statistical parameter of the test (t calculat – *t calculated*) :

$$t = \frac{\bar{d}}{\frac{s}{\sqrt{n}}} = \frac{2,54}{\frac{0,337}{\sqrt{11}}} = \frac{2,54}{\frac{0,337}{3,316}} = \frac{2,54}{0,101} = 25,14$$

$t_{calculat} > t_{critic}$

25.14> 2,228

Conclusion: t=25.14 €$(-\infty; -2,228] \cup [2,228; +\infty)$ As a result, the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore, we conclude that people evolve under the aspect of their capacity to love unconditionally, as they age. With a 2% (0.02*100=2) risk of error, we find that all of the subjects in the adult lot have a superior capacity to love unconditionally as opposed to the young people lot.

6. CONCLUSION: FREEING THE REAL SELF BY CONTEXTUALISING THE FEAR OF LOVE

Our true identity is not originated in our memories or in our past. Our individuality begins once again, at every moment, together with the attention we pay to ourselves and to life. The "now" stage, the true self is not culminatic, or something created at a certain moment in the future, but it is rather continuous, an organic whole that deserves to be lived. Currently, humankind is oscillating between the fear of love and the suffering resulting from the absence of love and is concentrating on its survival. Maybe this is the reason why we are only now beginning to understand the infinite potential of life. We concentrate on being aware of the righteousness traits of everything around us, which are impossible to deny, in order to convince ourselves that we are what have wanted to be.

But the smallest threat makes us go back to the feeling of uncertainty and control, which makes us doubt of what we are. Then, this inner lack of trust is transferred and we perceive the world as being threatening.

When we feel love, we discover that life is not about surviving, but rather about blooming, creating, consciously embracing each moment, while being fully aware of the limited fragment that we represent of a great whole. What is love after all?

Philosophers have defined love in different ways:

- "To give all, to sacrifice all without expecting to get anything in return, this is love", Albert Camus said;

-"Happiness and peace that cannot bloom until we free ourselves of the domination of our mind" according to Echart Tolle;

-"The strongest force the world possesses and yet the humblest imaginable" Mahatma Gandhi throught.

Psychologists describe it as something that starts with an overwhelming feeling or emotion that, in time, becomes a conscious choice and engagement that involves action:

-"Intimacy, passion and engagement" according to Robert Sternberg;

-"A combination of three elements: attachment, care, intimacy" according to Zick Rubin.

Biologist Pat Mumby describes love as "the state in which the brain is invaded by chemicals such as oxytocin, dopamine, adrenaline and vasopressin, whose effects are similar to heroin and that cause an increase in pulse".

Anthony Robbins, a motivational entrepreneur and financial trainer, the author of several books on personal development, considers that "love is the oxygen of the soul" and that this feeling is manifested in three stages during an individual's evolution, i.e.

1. The stage of "Love me as I am", which that is found in children, but which is not at all constructive in adults;
2. The stage of "I love you as much as you love me", i.e. conditioned love that is characteristic of our society, that causes suffering because each individual is different from the point of view of her/his own personal rules and needs, which makes the "exchange" inequitable.

It would be ideal for us to be able to overcome our dependency on others, our narcissism and our desire to exploit our peers or to accumulate material asstes. At this stage, love represents a symbiotic attachment or enlarged egocentrism. The parents' love for their children is unconditioned, in the sense that, this type of love, even though it does not follow a certain purpose or interest and it does not represent a transaction of the request and offer type, it still involves a kind of inner conditioning, in the sense that mothers love their children because they are part of them (this is related to that subtle narcissism: it is easy to love one's own child in whom one sees his/her own self), while fathers love their children if they see that their expectations are being met in the development of their children's potentials as they age (they love their children as long as they follow the predefined path set by them and once they become young adults and they decide in relation to their personal evolution, the fathers who have failed to reach a high level of understanding, inherently stop "loving" them).

3. The stage of "I want to give you what you need: attention, affection, safety, respect", i.e. unconditioned love, to meet the needs of others without assesing what one gets in return. At this stage, love is a power that produces love and the capacity to love means to give what is alive within us, which is different from sacrificing our lives for others; it is the act of giving in direct agreement with the degree of development of our character. As a power of the soul, love does not serve any purpose, but is a creator of love for the helpless, for the foreign, for the poor, even for our enemies. Psychologist Erich Fromm defines love at this stage as being rooted in the evolved individual's capacity to love, as an activity that involves care for life and the development of the loved one, responsibility, respect, knowledge, an active aspiration for the development and happiness of the loved one, for his/her wellbeing accomplished through his/her own means and without expecting any personal benefit. To love is a decision, a judgement, a promise and an act of will that guarantees the continuity of love. Love for ourselves and for others is not reciprocally excluded. The love we have for our own integrity, uniqueness, respect, and self-understanding cannot be separated from the respect and love we have for a peer. Self-love is not egoism. Egotistical individuals hates themselves, are unhappy and anxious, are obsessed with themselves, they are so poor that they cannot bear to look around or at others and have nothing to offer, tiring themselves to accumulate possessions in an attempt to compensate for their inability to truly take care of themselves. Under the pretext of maternal care, an egotistical mother will compensate for her inability to love herself by constraining her children, monitoring their every move and scolding them for any mistake.

Huxley believes that a person belonging to the consumer society has become more and more incapable of loving because "nowadays, happiness means having fun, i.e. the pleasure of ingurgitating/swallowing without chewing food, goods, images, beverages, cigarettes, books, films, people etc., without any profound feeling of the interior reality to which the individual belongs, that would bring them to catharsis and clarity of consciousness." True love is possible only if people talk to each other from the core of their existence, if individuals feel they are in the centre of their existence, since the foundation of love is "the central experience", i.e. true life. Love requires:

- *discipline*, i.e. accepting suffering (delaying satisfaction, accepting responsibility, devotion to the truth, balance);

- *concentration* (the capacity to be alone and, paradoxically, to love; to be sensitive with oneself by being aware of one's emotional state, without trying to find reasonable explanations thereof);

- *patience* (to make a distinction between one‘s objective image and one’s ego, i.e. the image that originates from one’s own desires and fears);

- *faith* (to find the courage to give up the defensive system in which distance and possession represent the safety means and to free oneself by assuming the risk of suffering disappointment and by accepting to open up to another person, regardless of the consequences).

Evolved human beings spend their energy for purposes that belong to their own sphere of interest and use means and rhythms that they alone choose, by becoming aware of and cultivating their own potential. They do not get angry and do not strain, they don’t resort to addictive behaviours, but they sit calmly, without speaking, enjoying to be left alone with themselves. They have learned to be patient, to contextualise their fear of wasting time if they fail to do things quickly, only to “kill” the time gained.

They exercise their faith at any moment: when raising their children, without suffering from hyperanxiety for them, when sleeping, without having insomnias, when starting to work on something, without having issues with the productivity of their work, when stating their convictions, even when such convictions are not generally accepted, without having any issues with getting closer to other people and without becoming hypochondriac. One of the main conditions of loving is to be entirely “present”, i.e. being thinking and feeling actively, observing by watching, listening and avoiding inner laziness and greed.

All the problems of mankind are rooted in the human being’s lack of love and faith. Without the courage and honesty to put an end to the illusion that others are guilty for what we are, our physical/mental/spiritual state would worsen. By entering the third stage of unconditional love as frequently as possible, we might generate the change we want in our lives, by us becoming the very change. The emotions that we consider the most difficult to deal with have their rightful place and role in the ecology of love.

The wisdom that love gives us is the source of energy that we need to keep the pace with the hardships we have previously run from. The evolution of the human being requires the individual to go through the experience of the self-transcendent power of their self-perceptive capacity. The individual does not have to change the world.

The only thing that is needed is for the entirety that is represented by the individual’s own being, which is always present and always seeking to awaken, to be restored. When we do this, we become the transmitters of a profound trust in life, we become leaders, we possess leadership and the world begins to change with us and through us.

Love is
to hope
to perform an act of faith

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INSTITUTIONAL MANAGEMENT OF CHANGE. RESISTANCE OF THE EMPLOYEES AGAINST ORGANIZATIONAL TRANSFORMATIONS

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Abstract: *The concept and practice of managing change has become more and more popular among organizations in recent years. The change, being a systematic process, involves several stages. Staging is a logical succession of pre-arranged, interfaced, and flexible operations. In order for change to be beneficial at all levels, it must be well-grounded and deployed according to a concrete situation-based methodology.*

Change management is a process that allows an organization to modify any part of its structure, so that it can cope efficiently in an ever-changing environment. This includes activities designed to provide support, acceptance and approval for the necessary and agreed changes. The goal is to control changes, while maintaining the integrity and quality of services in the production environment.

Keywords: *human resources,* competitiveness, *social phenomena, organizational transformations*

1. INTRODUCTION

Change is a continuous process that manifests everywhere in nature, in society, in organizations and also in small collectivities in our everyday life. The change addresses phenomena, things and living beings from birth to cessation of biological processes, specific activity.

Transformation is an indispensable process to life, no matter how it manifests itself, it is continuous and never ends, it does not have a final point. Organizations, structures are also subject to the change process. Change is determined by the extremely complex and dynamic way it is [1].

As a result, all organizations, as well as living organisms, are constantly subjected to new processes, adaptation and rehabilitation attempts and their reactive capacity of adequacy becomes, in this context, an essential premise of success, a condition of survival, living on new coordinates. Change is a reaction of the organization's response to manifestations, increasingly frequent changes in the environment, to the needs, requirements and conditions that are perpetual.

Changes in the internal and external environment are not only inevitable, but also necessary, because in nature, in the infinite universe, everything is in an evolutionary/involutive state in relation to the age and the life cycle of beings, foundations, things and phenomena. Changes in the organization's internal environment are primarily determined by changes in the mass of resources (human, technical, technological, innovation, information, real estate etc.) that the organization has at one time.

In my opinion, changes in the external environment are those that decisively impose organizational changes. The external environment is unmanageable at times. Change is the phenomenon of metamorphosis, changing from a relative stability state to another, a reaction to adaptation to environmental variations, consisting of transformations in form and content.

Under these circumstances, the organization becomes the object of change. The organizational management is subject to great responsibility for redesigning the structure appropriate to the new conditions in order to function in step with the dynamics of the location environment.

Transformations may concern all or part of the organization's (substructure) compartments in relation to the direct/indirect action of environmental factors.

The depth of change on the structure, character or nature of the organization requires reconsideration of the organization's mission, policy conception, policies, strategic planning and other relational elements.

The organization is subjected to the action of the external environment, which generates internal responses, resistance to defeat, or rather, to adapt to the new conditions imposed by the external environment, determining new approaches and responding to the outside world through the new attitude regarding the services better quality, then adopts the reaction response of other factors of the external environment for other adjustments.

So we have three phases [2]:

-inputs from the outside;

-the internal processes of the organization;

-organization's responses, outputs;

-reverse link, feedback response.

Change management is a complex process of organizing, coordinating and evaluating the transition of the organization from a relative stability to the society under the influence of environmental factors in order to adapt to the new conditions for the proper fulfillment of the planned mission and objectives.

Addressing change has become a habit for competitive advantage. Change is the attribute of the manager. And, hence, the need for him to know in depth the environment of the organization, the threats, the vulnerabilities, the opportunities, the possible arrangements etc. Environmental factors must be well monitored in their dynamics and continuously analyse, alert change signals to timely intervene in order to identify challenges and avoid possible dangers. First, the hazards of the external environment with major impact on the organization must be identified [2].

In an external fluid environment, anything is possible: some customers become competitors, suppliers can become partners and competitors move to other intangible areas with the organization in question. Understanding the need for change in a timely manner and immediate action can place the organization on an advantageous place that can influence an important segment of the environment. This sets the rules of the game and chooses a comfortable place to eat.

Change is inevitable and, as a result, no one should oppose it. Any opportunity should be exploited, even a 180^{o} change if promising.

2. FACTORS THAT CAUSE CHANGE

Transformations must be well prepared. The management, the responsible field of initiating and monitoring change, must be aware of, analyse in depth the action scenarios, test them when needed, pilot stations and only later to prepare for the organization; furthermore, there comes planning, organizing, coordinating and continuously evaluating the process of change.

Change is not for the sake of change and not in any way, but after a proper management of concrete conditions, not copied from others. Each organization has its own peculiarities, which determines us to say that there is no generally accepted preset prescription.

Creative solving involves finding innovative scientific ways appropriate to each particularity. Even the inside of the organization does not match the same methods of change.

When examining the conditions for triggering change, consideration should be given to political, legal, social, economic, educational, traditional-cultural, psychological issues etc.

The main determinants of change:

-legislative particularities (constitutional, organic and special legislative framework) in the field of interest;

-the local, national, subregional, regional, global economic environment;

-the degree of price liberalization;

-the exchange rate;

-the degree of stability/instability of inflation;

-ownership structure;

-access to information from the organization, versus access to citizens' information;

-internal order status;

-the banking system;

-the degree of state involvement in stimulating the field;

-influences of local, regional, global conflicts emerging (deployment);

-financial bottlenecks;

-law enforcement;

-the level of corruption on different levels of power etc.

We find that the politico-socio-economic environment is experiencing a process of accelerated transformation. These phenomena translate organizations into a situation of increasing the pace of change. Courageous managers, willingly, who believe in change impose development shocks and succeed. Change is accentuated and is a feature of our everyday life, must be perceived, conceived and applied [3]. The previously mentioned change is a complex process. Like any process, it must be well-guided and, as a result, well-known. Although the literature does not abound in explanations, we still intend to classify this process.

The change is classified according to several criteria:

a. By the magnitude of the changes:

- partial. It targets only certain aspects of the organization (resizing substructures, managerial reorientations etc.);

- total. Consider the whole organization (total or overwhelming majority of substructures).

b. By the degree of readiness:

- planned changes. They are anticipated in advance and implemented according to already prepared methodologies (procedures), reducing the risks of precipitated actions in a hurry. In this case, everything is moving in the way the organization wants;

- unplanned changes. They are reactive in response to environmental fluctuations. We have to deal with adaptation to imposed conditions and, as a result, there is always the risk of mistakes in how to design and implement change. Causes can be produced by justified, wide-ranging actions, loss of influence due to conflicts, natural disasters etc.

c. By the way of determination:

- imposed changes. They take place in emergency situations, under environmental pressure. As a rule, it creates dissatisfaction, opposition, tension. They are imposed either by management or by the structures of execution;

- participatory changes. In which, in one form or another, part of the organization's entire staff. Resistance to change is virtually null. It targets long-term changes;

- changes caused by re-technology. Performing technologies directly or indirectly influence the whole organization, such as putting into use an intranet, introducing high-performance industrial robots, replacing technology and modernizing transport means, introducing high-performance surveillance and control etc. All of this dismisses some of the employees, increases the professional-cultural degree of the organization, increases productivity, profit, product quality, lowers maintenance costs, widening sales outlets and more. Consequently, for redundant staff, solutions have to be found. For example, one of the solutions could be to set up new service substructures by re-training the workforce and adequately endowing with means of production, but there are certainly other profitable alternatives for the organization and its employees for the nation;

- negotiated changes. They are based on discussions aimed at harmonizing the interests of the negotiating parties and the joint agreement to support the implementation process.

2. THE STAGING OF CHANGE

Being a systematic process, change involves several stages. Staging is a logical succession of pre-arranged, interfaced, and flexible operations. In order for change to be beneficial at all levels, it must be well-grounded and deployed according to a concrete situation-based methodology [4].

Stages of change:

- external environment analysis;
- assessing the organization's response capacity;
- identifying, appropriating the need for change;
- preparing human resources for change;
- understanding the need for change;
- diagnosing the organization in sensitive areas;
- identifying variations of change;
- anticipating and overcoming resistance to change;
- choice of time and duration of change;
- maintaining the trend of change.

a. *The external environment analysis* is determined by the manifestations that take place. The change is driven by state-of-the-art technologies, new markets and citizens' preferences, government pressures and social expectations. The world has become anxious, hastened and so will it be in the future. The organization, through the possibilities it has, can not influence the external environment. It obeys the action of these external factors. Here are some of their manifestations:

• the withdrawal of global, regional, subregional political influence limits; social transformations in the area of the markets (demographic issues, population preparedness, urban/rural population ratio, average family members, population and age ratio, all analysed in dynamics);

• the trend of globalization of markets and the expansion of global cooperation in production (for example, a Volkswagen car, in fact, organizations from all continents);

• the unprecedented acceleration of technological upgrades (new information and communications technologies shorten life cycles, shorten communication times between people, generate new systems, infrastructures, unpredictable conceptions and developments);

• changing attitudes towards environmental protection (organic and chemical products and substitutes are increasingly being sought after).

As easily deduced, the organization, no matter how strong it may be, is not capable of confronting these phenomena from outside.

b. *Assessing the organization's response capacity*. The organization behaves like a living organism. It is born, grows, matures, reaches its peak, falls into decline and then goes bankrupt. Throughout the journey, it must be conserved, readjusted, redeployed, maintained through a specific treatment system at functional parameters. Management is the one who views at any point the stage of the organization and, depending on the state in which it is located, applies the appropriate measures.

Most of the specialists identified five phases of the organization's evolutionary cycle [1]:

• development through creativity (specific to the incipient period of the organization when the founder, with his vision and visionary style, is in the spotlight); towards the end of the phase there is the crisis of authority;

• development through management (when the need for an authoritarian manager appears, as the founder maintains in a melancholy state as a "good parent"); at the end of the phase there is the crisis of autonomy;

• development by delegation (when authority has become unbearable, and it has to be delegated to more hierarchical employees. This creates a strong sense of involvement of management teams in key-issues with the responsibilities arising from this phase). There is a power crisis, in which the power struggle takes place between professional managers;

• co-ordination development (when aligning top-down and bottom-up planning communication becomes essential, managers on different hierarchical stages behave according to the new requirements, a new organizational culture is born, and also a new perception of the employees). The crisis that occurs represents the bureaucracy in which the local initiative is stifled;

• collaborative development (where bureaucracy is replaced by simplification and integration of information flows, temporary multidisciplinary team work, co-ordination, co-operation is initiated from inside, not imposed from above). Expecting a new manifestation of crisis.

We notice that at the end of each phase there is a crisis that helps the organization to make the next step and move forward, which means a new challenge, agitation, emotions meantg to create new opportunities for change, but that does not have to represent a fear factor. However, the most difficult thing in management is to think about the modalities to interpret and act. This involves careful business monitoring, reporting reactions and well-directed actions.

The real assessment of the organization's capacity in relation to the external environment is of great importance, thus avoiding cosmetic, façade changes with no substance, consuming resources and time in vain at the expense of profound transformations. It is worth mentioning that the external and internal environmental factors could also be compared with a vector-powered coupler of communication. The more multidirectional the communication is, the more the result of the vectorial couple is to the advantage of the organization [1].

In the process of change, environmental conditions determine the response of management, which through appropriate strategic planning determines the necessary reorganizations in relation to the existing resources (human resource is essential), the technological changes and other internal factors. The strategy is the lever of change, provided that it is applicable at all organizational levels, that is, to be the fruit of their ideas, based on reality and flexibility. The trend in the organizational construction is

horizontal, citizen-oriented, network-based and autonomous cell-based (based on Integrated Information Technology) horizontal organizations (with a small number of hierarchical levels).

c. *Identifying and appropriating the need for change* is an important foresight stage. The role of infrastructure is essential, in particular, as regards:

- the forms and extent of organized cross-border crime;
- the migration and traffic routes etc. are are only a few of the factors that give the first signals of the need for change. The manager needs to consider, diagnose and administer "appropriate treatment".

d. *Preparing human resources for change*. Within this concept, the signal of change must be given by the manager by facts, not only by speaking. The manager is the receiver, the sensitive sensor of the messages of satisfaction/dissatisfaction of citizens and employees. It must ensure the transition from the vertical to the horizontal management by decentralizing the responsibilities and responsibilities to management on the inferior hierarchical levels, to be the catalyst of change, to reconsider the importance of work and the particular life of human resources, to promote the use circuits and information flows [5].

The manager needs to have expertise in evaluating strategies, in managing human resources, in intelligence, in settling misunderstandings and as such dividing its working time. Then human resources have to be taken into account in their organizational integrity (rewards, career development, self-evaluation, communication, effective operation etc.).

Competitiveness in the profession on the labour market is decisive. With well-trained people, change is perceived as appropriate and applied unswervingly. Self-evaluation and evaluation must be real [6]. Electronic mail, teleconferencing, internet and intranet, voice mail are the first-ever elements of change. Progress in information technology places humanity, with or without our will, on other coordinates. Getting rid of obsolete "agendas", moving to computerized technologies. New behaviour involves abandoning old habits. A core component of the organization is organizational culture (traditions, history, ideas, values, behaviours, titles, merits, medals, and other characteristic elements).

Change can not be cast out. The reality is that it presents itself as a continuous dynamic process. All we have to do is change our mentality. In this direction, the preparation of human resources for the acceptance of change must be oriented.

e. *Understanding the need for change*. Human resources must be encouraged to understand the coordinates of the organization and where it should be. The past is history and must not be insisted too much on it. It is good to draw conclusions from the past, in order to enrich our experience. The main focus has to be on what is no longer the result of new learning in the field, the circumstances of change, practical opportunities, encouragement, the creation of support mechanisms, rewards/sanctions, evaluations, the continuous training of human resources. The risks, the ambiguities, the social safety conditions, the need for emulation that is favorable to change and the long-term change should be explained.

f. *Diagnosing the organization at sensitive points*. It is, indeed, of great importance for finding the symptom, what to do and how, what results are expected. Often, the crossroads are not well formulated. In order to clarify them, meetings between managers and employees are important, and appropriate questionnaires are applied. This way, the scale of specific problems will be better outlined and, therefore, better addressed. After diagnosis, goals of change, attitudes, morality etc. are set. All this must lead to the growth and development of the organization, competitiveness, efficiency, effectiveness and flexibility in new conditions

g. *Identification of variants of change*. At this stage, it is aimed at changing the structure, behavioural aspects of employees, technological renewal. Structural change refers to improving the performance of substructures, optimizing management-execution ratio, hierarchical levels, relational and informational procedures and structural interdependencies.

Behavioural issues are in the field of motivation, education, professional competence, attraction in decision making etc.

Technological renewals must be related to the structures and the level of user training.

h. *Anticipating and overcoming resistance to change* is the main attribute of management at all hierarchical levels. Resistance to change is an attitude, however normal, for the fear of the unknown, the uncertainty, the care of tomorrow. That is why all these manifestations must be anticipated, identified and treated accordingly and knowingly [3].

Resistance to change is due to some causes:

- doubt in managerial capacity to implement change;
- the suspicion that the timing and methods chosen would be inappropriate;
- neglecting employees' proposals;
- the consequences of mistaken decisions previously taken;
- low tolerance to uncertainties and ambiguities;
- misunderstanding the implications of change;
- the fear of losing the job, of power, of freedom, of authority;
- ad-hoc formation of groups, outbreaks that promote resistance to change.

On a case-by-case basis, management intensifies training, education and communication with employees, engages in explaining the reasons for change, providing support, organizing and conducting negotiations to improve asperities and resilience points, manipulating and cooping those who resist due to their optimism, correcting the attitudes of those who persist in resisting change through threats (job loss, transfer, non-promotion). Tact and diplomacy must characterize the way management is approached by change.

i. *Choice of time and duration of change*. Optimum time is sought depending on the previous operational cycle of change. The duration of change is determined by the influence of environmental factors, the scale and complexity of the process, technological operations, investment, procedures, culture and organizational traditions and others. Planned and monitored compliance with preset deadlines.

j. *Maintain the trend of change*. The change must be irreversible. For this, most members of the organization need to accept and support it [6]. It is also necessary that its propagation within the mass of the organization be manifested as a wave that trains everything in the way.

3. CONCLUSIONS

In order to overcome the insecurity of those who resist, as well as the undecided, intense, multi-point communication is required to propagate in all directions and the media of the organization, from top to bottom, from bottom to top, horizontally and diagonally.

Transition periods create insecurity and crises because it starts from the known to the unknown. The ambiguities, insecurity, inherent stings in such situations can be combated, clarified and elucidated only through open, trust-based, active, continuous communication, differentiated by socio-professional categories, hierarchical levels and preparation from superior management to the last formation and member of that organization.

Communication is an exchange of information. Whoever holds the information holds the supremacy and control. Information is the antidote to fear and panic. In order for the change to have an upward trend, the information needs to be unitary, customized where it is needed, well-directed and monitored. The open, bilateral and bidirectional communication style has proven its effectiveness for irreversible and lasting transformations. Honesty is the sure success in communicating change, in the understanding of its valences by the subjects. The change also has good news and bad news, it has to be openly discussed, male and solved consensually as such. In most cases, the manager does not know what he is expecting, he does not know the answers to all the questions, so repeated and well-thought-out talks and negotiations are to be held. From these, answers will be born. But this requires time, patience, tact and perseverance, finality.

Any dynamic business creates surprises and that is why the manager has to get involved early (preventative) in discussing tricky issues. All members of the organization are interested in how change will affect them, the reasons for change and, as such, it is very important to communicate the vision of change and destination. The mode taken for change is the greatest weight for management. Members of the organization need to inoculate the idea of "ownership" on their place of work, and then they will join more easily and become more receptive to change.

Communication channels and streams are kept permanently open. It is preferable to set up teams for cascade communication, to present documented videos, to employ specialized organizations for bilateral exchange of opinions.

Specialty literature also sets out some benchmarks about the manager's attitude to communicating change:

- not to criticize his predecessor;
- not to attend the meetings without being prepared in detail;
- not to disinform the subordinate staff;
- to prevent communication void;
- to accompany the message of communication with measures to be taken;
- not to consider himself absolute master;
- not to discourage close collaborators and employees in organizing meetings for change;
- not to rely solely on reports and information from subaltern echelons, but to focus more on discussions with people;
- to realize that the change affects the organization as a whole, not only the individual per se.

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MODERN CONCEPTUALIZATION OF THE EDUCATIONAL MANAGEMENT PARADIGM

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Abstract *: Managerial reform in the educational system as a fundamental pedagogical concept implies a rigorous epistemic construction based on the development of a paradigm able to detect the malfunctions in the system and to control the prerequisites, principles and operational notions that determine the development of innovation in the field. Educational management presents itself as a fundamental psychosocial activity, designed according to some finality elaborated at the level of the macrostructure of society in order to accomplish its specific central function of valuing the individual and his abilities, evaluating in the direction of a superior system of humanization - towards self-management. The paradigm identifies managerial activity in an era of change, guides the direction managers must follow, provides a deep understanding of how the various elements and principles apply and link together, provides the ability to act, to accomplish what needs to be done in a new conceptual and situational context, renouncing the old concepts and skills.*

Keywords *: paradigm, reform, alternative, principles, capitalization*

1. MANAGERIAL PARADIGM OF THE EDUCATIONAL SYSTEM

Conceived as an ensemble of beliefs and values, schema, model, the paradigm becomes indispensable in situations of "anomaly" or crisis of a system that calls for new concepts, revolutions or conversions in the faith of the scientific community and psychological and social factors, oriented towards a change of mentality and sensitivity, "which makes us live in a new world."

The experience of the transition years towards a new education system, as well as the results of investigations into leadership practices under these conditions, indicates that not all the levers of change have been used to support the new educational goals and objectives. The replacement of the traditional teaching and non-curricular with the curricular system has not integrated the management system, which has remained centralized, without changing the essence of the mission of the school organization in the context of social transformations, the environment, strategy and structure, relationships and networks, the information and communication system, the motivation and stimulation of staff, etc.

The results, quality of implementation of new guidelines and educational content depend directly on the judicious, competent implementation of planning-organization, guidance, regulation-self-regulation functions in the education system, appropriate to the changes in the field. It is clear that education reform needs not only an administrator but requires a real manager. The leadership crisis calls for the ability to "tackle larger issues," to "have a global and creative vision," to "positively influence" the functioning of the system as a whole. The managerial structure thus designed can establish a "new administrative constellation".

It appears as a reforming alternative to "anonymous and blind administration that has, over time, reinforced the bureaucratization of the education system and its hierarchy in a network of relationships in which the teacher does not have the power of an individuality."

The evolution of general management after St. Covey refers to four management paradigms presented in the figure below:

NEED	METAPHOR	PARADIGM	PRINCIPLE
Physical / Economic	Stomach	Authoritarian, scientific	Correctness
Social / Affective	Heart	Human relations (benevolent authority)	Kindness
Psychological	Mind	Human Resources	Use and develop talent
Spiritual	Spirit (the whole person)	Leadership based on principles	Sense

The principle-based leadership paradigm (complete person) says: "Let's talk about vision, goals and roles. I want to make a significant contribution." Expressing our attachment to the cultivation of the principle-based paradigm, we mention the need to promote a proper educational paradigm from a democratic perspective in the specific conditions of society. In this context, the managerial reform in education, to be achieved on the basis of the new managerial paradigm, as well as the reform of the general education, "falls within the category of fundamental concepts and targets the following prerequisites:

- Relating the managerial reform to the existing and prospective situation of the Romanian society, which launched objectives for joining the values of democracy, the functional market economy and the culture of a computerized society.
- Relating to the existing situation in education and, in particular, to the evolution of the management system with an indication of existing dysfunctions, requiring "profound restructuring rather than simple renovations".
- Relating the management system in education to a modern, democratic-participatory management by promoting a new paradigm of educational management.

2. CHANGING THE PARADIGM OF THE MANAGEMENT SYSTEM IN EDUCATION

Pedagogical innovation on change of leadership is determined by changes in the global social system and the educational system. This involves putting management leadership in the foreground, expressing the values of science and politics in the respective field of activity. From this perspective, on the basis of the investigations undertaken and taking into account the managerial theory and practice, it is necessary to implement in the education system a new paradigm of educational management from a democratic perspective and of European integration, a paradigm that signifies a major change of the education management at level of system and school unity, the struggle between tradition (in the sense of the old stereotypes) - training the executing man through the promotion of authoritarian-bureaucratic management - and innovation - training the decision-maker through the implementation of a modern and autochthonous, democratic-participative management.

It is the proposed strategy that offers the opportunity of a unifying vision of the school system and organization.

The strategy is to value the individual, his abilities, to train the decision-maker, a strategy that is in line with the vision, the mission of the contemporary school, the targets of the democratic society.

Starting from the thesis that "education itself is a goal" and considering the "two complementary dimensions of the educational ideal: the social dimension - the psychological dimension", the strategy conceived as a description of the mission-related decisions and the desired results provides at the system level and school unity - training the full personality, able to make independent decisions, the capitalization of the individual and his capacities, the finality which "synthetically expresses the correlation between the society and the educational action, namely the fundamental demands of the society towards the educational action". The orientation towards training the decision-maker, capable of making independent decisions, signifies the level of self-management, individual self-government, the degree of freedom in education and the assumption of responsibility towards the results of this action, consolidates and facilitates the self-determination, self-accomplishment of the individual. These increase personal efficiency, determined by the paradigm of the seven success stories of St. Covey (to be proactive, to begin with the ultimate goal, to give importance to priorities, to think gain/ gain, to first understand and then to be understood, to act synergistically, self-renewal), strengthened by valorisation of endowments of one's human knowledge: self-knowledge, imagination and consciousness, power of will, mentality of abundance, courage in balance with respect, creativity, continuous improvement/ innovation.

From the point of view of the educational ideal and the approach of human development (philosophical, sociological, psychological), the paradigm of managerial reform aims at training the decisive man in the context of redefining his national, social and cultural-spiritual identity, able to make independent decisions in a democratic perspective, which implies the establishment of specific relations of interdependence of the individual with society, relations that "express the primacy of the individual and his interests in the social life, transposed into the political, economic, moral, legal, theoretical, aesthetic and religious values reflected in the norm of social and cultural behaviour". In this perspective, human-centred management, competence management, value management, and quality management are the main drivers of "integrative leadership" claimed by modern society. Valorising the individual and its capabilities as a major objective of the educational management requires a new strategy in the spiritualization and axiology of value-based competencies. The subjective approach of competences leads to lowering the determination of man by the institutional structures and to the increase of the role and weight of the individual elements, of personality, i.e. subjective. Competencies predominantly involve voluntary actions, free personal decisions and, therefore, responsibility, imagination, energy, innovation, exiting from habit, approaching art management. Thus, a shift from a logic of power to a logic of competences is required, a situation that is particularly necessary for the learning society and specific to the school organization that teaches and produces learning.

The overall managerial goals at the system and school unit level correlate with the new orientations and realities, proper to a democratic and open society, with the directions of the education reform, the strategy of the conceptual model of managerial goals. They are organically linked to the value system and indicate the direction of development of education in general and the formation of personality, in particular, values that ensure socio-human progress. Managerial goals aim at the same general pedagogical goals, being aligned with society's demands on education, but it specifies the key aspects of support, educational management, and support in achieving the intended outcomes.

General management objectives aim at changing paradigms and attitudes, managerial professional training and implementation of new leadership technologies, motivation, engagement/ participation, ensuring equity and quality in education.

The overall management objectives ensure the transition from the macrostructure finalities (goals) to the microstructure ones, from system to process. At the level of the managerial process, the general and specific managerial objectives aim at reconsidering the content of managerial activity, the diversity of the "conceptual" managerial leadership approach, the complex application of management functions, the ways of manifestation of management and leading styles in situational context, involvement of educational actors, community, advisory boards, informal leadership organizations.

The complex management model is in line with the educational values and goals promoted by the reform of education and should be conceived only as an integral part of this process of social change. The orientation of changing the finalities of managerial action in the sense of reforming implies mastering the "sources of divergence" and their valorisation in the direction of shaping the pedagogical ideal determined by the finalities of education. Thus, a strategy of changing the management system, specific to the national character of this social phenomenon, is initiated, in parallel with the "universality" of management. This creative product corresponds to the context of the model of managerial social rationality, which determines a functional hierarchy from a pedagogical point of view and participatory from a social point of view. This opening pledges, in essence, "to achieve the leap from traditional pedagogy to contemporary pedagogical sciences". But modern trends reflect the managerial evolution of the institution at the post-industrial, socio-cultural levels of society.

3. THE MATRIX OF INNOVATIVE MANAGERIAL DEVELOPMENT

It is obvious the great importance of examining the correlation of managerial areas with the systems indicated and the managerial tools applied in each particular case, which elucidates the leap from the bureaucratic leadership to the conceptual management leadership. One-sided application of only one system is possible, but it does not produce the expected change in organization. From this perspective and on the basis of the researches carried out and described above, we have developed the matrix on the technical, political, cultural, existing and future fields, applying the respective management tools. The methodological assemblage of the three technological, political and cultural perspectives provides an integrative and open paradigm of the scientific community that builds the prerequisites - the principles - the operational concepts of managerial reform similar to the global reform of education, which creates credibility and veracity.

The future-oriented matrix reflects the application of the conception/ strategy of the educational management, which is of a community type, provides the involvement/ participation of educational actors in the life of the organization and is a creative management, its actions are producing ideas, solutions, projects that come to capitalize on the essence of the educated. Such an approach based on the three perspectives - technological, political, cultural - ensures a creative process in changing the conception of leadership from a static state to an evolutionary one, of progress, innovation, from a leadership dominated by inertia and inflexibility to a leadership dominated by activism and initiative, from a leadership focused on constraining the behaviour of members to focusing on empowering them, from reactive leadership to proactive leadership.

The paradigm expresses in this sense a new way of thinking and working, a new direction of leadership, conceived as complex assemblies of phenomena concerning "how leaders think about their own leadership activity, their tasks, the ways to achieve their concrete relationship with their subordinates, peers and superiors. This involves a new mentality of teachers with leadership functions, new attitudes, opinions, skills to act.

	Mission and strategy	The organizational structure	Human resources management
Technological system	▪ promoting an own educational policy ▪ learning community oriented towards egalitarianism, cooperation, success ▪ establishing your own budget ▪ pay according to of the work results	▪ network structures, emphasis on individual valorisation ▪ determining own structures, appropriate to the predetermined objectives	▪ competence-based activity ▪ selecting staff according to their own/ competency criteria ▪ appropriate reward ▪ (self) training
The political system	▪ school autonomy, voluntary actions, personal decisions ▪ medium and long term planning ▪ particularism, the need to adapt the conditions of change and specific relations to concrete situations	▪ decentralization ▪ the delegation of power and authority ▪ supporting informal structures ▪ effective leadership styles	▪ decentralization of decisions ▪ empowering people, making decisions through consensus, and deploying them jointly ▪ involvement/ participation in organizations' lives ▪ independence, emphasis on results and process
The cultural system	▪ high organizational culture ▪ vision, beliefs and common values ▪ responsibility, imagination, fantasy, out of habit, approaching art management	▪ open communication ▪ open climate ▪ relationships of collaboration, respect and trust	the human resources system shapes and forms the culture "without borders" ▪ collaborative peer relationships

The new paradigm of educational management, being applied, facilitates the promotion of an adapted and effective leadership style, participative and open to innovation and truth. Practicing it will strengthen the school organization, contribute to its development and its tasks.

Thus, the approach of leadership, as well as the phenomenon of education in general, has long been closely related to a philosophical and political conception of man and society. The development of education as a science involved the creation of a descriptive, explanatory approach that facilitates the evolution of human conception on the school, which puts into practice the valorisation of human resources, ensuring the transition from the vision of "a group of individuals to an assembly of groups in interaction".

The innovative approach to the new educational management paradigm converges towards the development of the "innovative school" as a moment of change in the evolution of education with the definition of the characteristic elements for the functioning of the innovative education, which employs all the managerial structures of the school organization:

- the intensive innovative development of the institution, the application of advanced experience regarding full participation of the educational actors in the design and realization of the educational finalities;
- integrating innovation from conceptual and methodological points of view by "training a data bank in school", sufficient to apply the advanced experience in forming the becoming personality;
- the reconstruction of the educational process according to the established objectives (social, political, pedagogical, psychological) in the perspective of education in the spirit of democratic values;
- appropriate selection of didactic technologies, intensification and optimization of the instructive-educational process;
- individualizing and differentiating training to create the conditions for the most complete and useful development;

- continuous teacher training to keep up with the new tasks required by a renewed pedagogy based on the requirements of the society and student and community choices;
- revealing the potential of each student by establishing a psycho-pedagogical assistance system;
- streamlining the inverse connection, through which individualized adjustments can be made to ensure higher school returns.

The new paradigm can be achieved on the basis of the following principles deduced from the results of the researches carried out, reflected in different bibliographic sources:

- the principle of empirical substantiation and of "scientific centralism" provides for consideration of the previous state of the management system, eliminating all its malfunctions, and its alignment with the management of science.
- the principle of philosophical orientation implies that the new leadership model should be based on a thorough philosophy of education centred on man and his fulfilment.
- the principle of realism requires the new management system to relate to the current and future trends of the development of society and to the individual choices.
- the principle of balance implies actions according to the three perspectives/ management areas, which must be correlated, adjusted to produce a quality change.
- the principle of the efficiency of managerial activity, based on the application of information and decision-making methods, the involvement of people in the decision-making process, the stimulation of the initiative, the optimal use of all resources.
- the principle of democratic character and participatory leadership promotes the unity of action of all factors that cooperate in achieving the objectives and tasks set.
- the principle of dynamic leadership is based on an effective style and compliance with rules of conduct, promotion of responsibility, prestige, authority, order, discipline, reflection, moral and financial incentives, etc.
- the principle of organizing and rational programming of all managerial activities in relation to the objectives set is to ensure efficient and effective management.
- the principle of permanent innovation of managerial methods and technologies, of teaching-learning-evaluation methods, of scientific-methodological research.
- the principle of ensuring the implementation of the new paradigm of leadership in education requires legislative, normative, material, financial, human support and competent managers.

The paradigm of the educational management reform is correlated with the principle-based paradigm, initiated by St. Covey, which is focused on the Complete Man. Thus, people are viewed not only as economic, social and psychological beings, but also as spiritual beings, they want significance, they want to be accomplished, they want goals that raise them, they want the work to fulfil them. St. Covey sets four levels of leadership based on principles: personal, interpersonal, managerial, organizational. At all levels, in order to be successful, it is necessary to work on principles such as the quality of being trustworthy, trust, empowerment, alignment.

St. Covey believes that the constituent elements of the organizations are: the staff, the skills, the shared principles, the self, the style, the structure, the systems, the strategy.

Thus, the need to move from "bureaucratic leadership" to "conceptual" managerial leadership implies a globalist, integrative, structural-generative, transparadigmatic and synergistic thinking. Such a "pattern of thinking" becomes imperative in a period of crisis of leadership and uncertainty that demands reforming solutions.

This system of statements as an "integrative and open" model provides a "qualitative synthesis", capable of attracting most researchers and practitioners through "conversion" to "a promise of success." Pedagogical innovation is determined by two types of transformation at global, structural and functional levels:

a) "Managerial pedagogical change" in conjunction with similar processes triggered in political, economic, cultural and, above all, administrative plans, which are the choices of a democratic society, a change that affects the functioning and structural relationships of the entire education system;

b) "Managerial pedagogical change", aimed at improving the quality of management practices at the level of school unit, adequate change to the new educational policy of training the free man, who able to make independent decisions in social and individual life.

The educational management paradigm launches a new system-wide strategy aimed at implementing a modern and autochthonous management designed to ensure the development and functioning of a prospective, competitive educational system, the transition from sociocentrism, a paradigm that maintains the training of the man-executor, at the paradigm of the curriculum, centred on training the decision-maker, able to opt for a certain state and social construction that will help and encourage it in determining its own path of individual development and career in accordance with its aspirations and the demands of society, local community. But precisely authentic educational management comes to support and stimulate by all means and possible ways the democratization of education in its essence with reference to content, structure and process, which naturally and logically implies the democratization of the education management in the hierarchy of all its structures, methods, techniques and tools, as well as modern managerial practices.

This fundamental change to be achieved in our educational system will ensure transition from the "administrative" to the "management" leadership, taking into account the new educational objectives and the expected results in the formation of the personality. As mentioned above, in the case of the "administrative" type of leadership, the main emphasis is placed on the functioning of the organization, its procedures and its efficiency in the determined structures, while in the case of the management the emphasis is on results, these being obtained due to the conception of the necessity of carrying out the tasks of the organization and the aspirations, the choices of its members through development and optimization of the organization, the effective application of management functions. Moreover, the new conditions of managerial activity, determined by the changes in the external and internal environment, require not only a performance manager, but the presence of the leader regarded as a driver of transition, who is visionary and pragmatic, communicative, possessing the sense of consensus in addressing the problems and taking decisions. Motivated , it guides the direction to be followed and animates people to noble actions. The manager conceives, develops and optimizes through performing functions within formal organizational structures, strives to limit risks, while the leader is an innovator who takes risks, transforms by changing roles and mobilizing people. If the manager usually works formally, exercising his or her authority as a leader in the organization, then the leader usually has an informal social influence.

Or, this issue is not given the proper attention nowadays when we are in a transition period, which maintains the administrative leadership, retains the implementation of management and leadership, "leaderism", which, in fact, is conquered within the group and is not "preassigned".

Raising to these three levels of leadership (administration, management, leadership) will be produced successively as favourable conditions are created that will, to some extent, require acceptance of management and leadership levels. For example, decentralization of education creates, first of all, these prerequisites.

Promoting the idea of school autonomy, the director will have more and more opportunities to manifest itself in the role of manager. In this context we refer to the possibility of designing the curriculum at the school's decision, the right to engage in work, to procure resources, to create a strong partnership with the local community, etc.

4. CONCLUSIONS

Extensive changes in education with regard to the implementation and development of the curriculum, pedagogical teaching-learning-assessment technologies require appropriate managerial skills from the director, who in the future can and must become a true leader-manager. At present, our society as a whole and education in particular need leader-managers to promote a leadership style appropriate to the new orientations and realities of a democratic and open society. Applying innovative principles implies mastery of theory, methodology in the field, a new mentality and own ways, a guiding art, which will outline the characteristics of the educational management paradigm. The implementation of a modern and native management in education is intended to contribute to enhancing the quality of education as a whole, democratizing school life, shaping pupils' personality in the context of a democratic and open society.

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LIE IN POLITICS

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Abstract: *This article aims to emphasize that lie has always been a vital and fundamental political tool. What is new is its theoretical metamorphosis in alternative truth. The essential question today seems to be, "What is true anymore? The political arena finds itself second in the military field, in relation to the terms of preponderance of lies and tolerance towards it. In this context the importance and the philosophical significance of the debate on the epistemological status of post-truth, alternative facts or counterfeit facts should be very well understood and known. If in the political sphere the lie seems to have found its rightful place, ranging from the gross falsification of reality to the "benign" lying through omission, this is because there are well-established and time-driven discursive strategies.*

Keywords: *lie, political actor, political speech, public opinion, intentionality*

1. INTRODUCTION

The main reason politicians lie is because their audience does not want to hear the truth. People want to hear what they want to hear. When two candidates hold their speech, and one of them tells the truth and the other only what people want to hear, the second one will win the election.[1]

Most citizens do not trust governments or parliaments, and most of them despise politicians and political parties believing that their government does not embody the will of the people. This includes advanced democracies as well, for numerous public opinion polls show that public trust in governments, public institutions and political actors has declined substantially in the past three decades. Why is it so? Surely due to dissatisfaction with certain policies and the state of the economy and society. Public opinion polls show that political mistrust can be predicted with the utmost certainty based on the perception on lie and corruption.[2]

Benjamin Franklin is the one who, at some point, being disappointed with politics, made a statement that was based on a careful observation of gaming interests in the sphere of governmental decisions. This statement highlights the limits of the false discourse: you can fool everyone for a little while, you can fool a part of the world forever , but you will not be able to fool everyone forever. His judgment adapts very well to our times, as demonstrated by those who have transformed lie into an effective practice to achieve particular purposes. All stratagems imagined over time have provided a considerable historical career, but it would seem that they were never able to effectively expose their discourse as they could in the media age.

2. TYPES OF LIES

In order to better understand the reasons for this success, first it is necessary to state out the existence of two different categories in which the discourse of those who practice the intentional lie fits:

-The first category serves the immediate interests of the lying one

-The second category targets the altruistic and charitable lies

The political lie fits in the second category. Political actors have in mind the important gains that are related to the access of controlling the strategic assets. For them, misinformation is defined as a source of data with preferential character from which it is possible to obtain a maximum of potential advantages in relation to the ignorant mass.

Lying can serve charity only when referring to "public lying", aiming to calm community worries. Lie is useful to society when its concern is to serve the common interest and not the personal interests.

This kind of situations are numerous and they maintain the illusion that the existence of lie in politics is a necessary evil, and those who practice it are acting as such based on the conviction that in this way it protects the superior interests of the community it governs.

Often, however, the difference between the concept of political wisdom and lies told by the political leaders is difficult to notice, because the ambivalence of the political power consists in this kind of amalgamation of the public interest with the private or the group interest. From the point of view of group interests, the ultimate purpose of lie is to save forces by manipulating the symbols instead of making use of their actual and direct nature. When a political leader gives reassuring statements to citizens, in secret he can organize an aggression against the public interest.

The mechanism of misleading consists in an exercise to eliminate the opponent's suspicion, so as when he should oppose a decision that could seriously harm its interests, he would be unprepared. The group interest has in mind a very important economy of means that could be wasted by trying to impose by force their unilateral will. So, from this point of view, there are two types of public lie: the tactical and the media.[3]

The tactical lie implies a deliberate dissimulation of the intentions of a person or a group of people that are left unknown to the opponents, forcing them to make bad decisions and thus being able to surprise them with certain decisions that concern them. Dissimulation involves not only a tactical silence on the part of those who practice it, but even a change in their behavior in order to not betray their intentions.

Media lie requires a form of mediation in promoting the group interest. More specifically, it is the image of the opponent, and not the opponent himself that it is targeted and the method by which he will be removed from the race involves the public opinion to denigrate certain behaviors, attitudes or values that are considered conservative or directed against the interests of the community.

When lie is inserted into a media discourse, it becomes an effective way of intoxicating public opinion with false interests and false enemies.

There is a strong and truthful motivation in favor of a false speech. Almost always, the political actor invokes the excusable lie, armored with solid arguments to exonerate itself. The preservation of secret has always been one of the main concerns of those in power. If in the past governance issues were in fact a matter of initiation in the mysteries of power play, they have now become the pretext of a direct relationship between public authority and citizens. The media offers a great deal of support to this dialogue through its technical possibilities to put face to face the protagonists of this relationship.

Secrets have disappeared and transparency has become real, but only in regard to the means and techniques used to guide the political action.

This is because, behind closed doors, the real goals and interests pursued by the leaders remain a never-dying occult reality. The mystery surrounding the power would disperse when society itself would cease to be a perpetual unknown for those who decide its interests.

The purposes, targets or objects of lies can be those facts, intentions, beliefs, opinions, values, or ideologies that posses the ability to substitute each other in order to rebuild reality in accordance with the aims pursued by those who are at the origin of the lying speech, or which show the ability to use the consequences of this practice in the world of the political life. To counter the verifiable nature of this type of discourse is difficult in most of the circumstances that involve attributive goals, value judgments, mentalities, ideas, conceptions or attitudes marked by a profound political subjectivism.[4]

If the lie misrepresents facts, where their interpretation is univocal, their direct observation is the most convenient way to find significant discrepancies between reality and its discourse.

When the speaker asserts a reality, he knows all too well what he intends to communicate: to respect his promise of transparency and honesty or to deliberately breach it. If the other is ignorant of these intentions he would formulate only certain conjunctions on the sincerity of that discourse. However, if someone is accusing him of lying, the lie can be appreciated more as a particular form of an intentional process, therefore the veracity of the discourse involves taking into account a certain ethos and a system of values that can characterize the context of its course/ progress

The problem is that values cannot be considered neither true nor false as long as they are viewed more as purposes and less as realities or facts. When we talk about justice, freedom, good, etc., we cannot question their demonstrability, because they are mainly highly biased options .Still, one can lie preserving the resemblance of values, just as Ceausescu was trying to persuade Romanians that the assertion of Western products is an act of great patriotism that serves their most personal interests.

At the same time, neither can opinions be considered completely true, nor completely false, being, in principle, things that are questionable and possibly disputable. However, a lie can be told either by promulgating ideas and opinions without really sharing them, only for pragmatic reasons related to the relationship with the reference group, either by deliberately publishing fake results of a public opinion polls. In both circumstances, the adopted behavioral model has in sight the practicing of a subjective opinion that respects the demands of the silence spiral, involving less the promotion of lies and more its acceptability.

3. WHAT IS POLITICAL ETHICS?

According to Encyclopedia Britannica, the concept of “ethics” refers to the establishment and analysis concept of right or wrong behavior, “being concerned with what is morally good or bad, and being applied to any system or theory of moral values or principles.”[5] On the other hand, as stated in Cambridge Dictionary, “politics” refers to “the activities of the government, members of law-making organizations, or people who try to influence the way a country is governed”, but also “the job of holding a position of power in the government” and “the study or the ways in which a country is governed”.[6]

Raymond Polin studied the relation between ethics and politics he stated that "ethics meditates, defines and appreciates, in good and in bad terms, the intentions of the acts and works of an individual considered in himself or considered in relations with the others individuals."[7] Regarding the Raymond Polin phrase, ethics is actually a moral theory, a "practical theory", which point out the moral practices, the moral actions, the moral relations, a moral behavior, principles, rules of practical conduct, human beings are freely interact inside differently social groups from their society.

The politics is more the way in which a country or a society is governed, so we can say that the politics is the practice of governing the human societies.

Politics is a human activity and it is fundamental in building societies which are built on laws, rules and defining values for the communities. Politics "requires a high level o responsibility and commitment from citizens, political parties, parliamentarians, government executives, the judiciary, the media, business, ONGs, and religious and educational institutions."[8] Considering some research about the trust of people in national institutions and authorities, in any countries, we see that the confidence is at a very low level. One of the biggest problems is the corruptions and the fact that the common interests are not that important, but politician special interest is on top of the list. Of course, that there are politician that seek the common good and fight in national and international level for their convictions, but the majority of individuals consider that ethics in politics is a sort of contradiction, mainly in practical activity.

4. OPINION POLLS

When we talk about public opinion polls, the situation changes radically when they no longer appear as a simple summation of individual opinions, but they are presented as a social fact loaded with significance at the level of a entire social reality. In this case, distinguishing the truth from the lie urges us to identify the source that mediates them so as to find out the nature of the intended intentions and purposes. Normally, the hypermediatization of public opinion polls that take into account the dynamics of the voting intentions of the population exceeds the strict methodological framework of sociological and political theories, thus entering the territory of the persuasive discourse of electoral propaganda by choosing the moment of publication in accordance to the position occupied by the sleeping partner in the top of the political preferences of the citizens. This process goes beyond the cognitive endpoints of testing the public opinion to step into the sphere of the most competent practices of political manipulation and misinformation.

In the disputes between politicians, strong arguments appeal to public opinion polls, and contesting the results vulgarizes the value of an important sociological technique when it does not corroborate their perception regarding the electoral reality. To insist on the fact that the opinions of many are one and the same with their beliefs or political convictions is an unlawful way of replacing reality with the desirable expression of this reality, to which the political actors interested in dominating the field of electoral disputes in the period between campaigns resort to. From this point of view, a conviction is appreciated as being true so far as it belongs to the party's adherents and supporters, or is considered false if it belongs to the political opponents. So, one can lie either by mimicking adherence to an idea or conviction, or by displaying a false respect for it, but public opinion polls are not capable to substitute opinion with belief.

Lastly, we are entitled to talk about lie every time certain objects of thought, such as beliefs, convictions, ideas, opinions, values step in.

However, the condition under which we can talk about it is to constantly report it to reality and not to thinking, thought, on which it is very difficult to express a pertinent point of view, because it involves some complex processes of a subjective nature which concludes by ingraining a relative character to any product of knowledge and from which lie derives more arguments in favor of its veracity and truthfulness than in favor of its falsity.

If realities are hard to know and see, they can instead be more easily deformed as they become more complex. This complexity always gives birth to complications of comprehension, especially where there is a lack of adequate means to understand the nature of the social action purposes.

We can say that the possibility of lying is directly proportional to the absence of testimonies and competent witnesses of events that take place in a hectic social reality, especially a reality that is in constant change. Almost all the time the lie refers to the past, and only occasionally to the present, these situations being associated with apocalyptic projections, depending on certain interests that always are 'up to date'. But most often the lie refers to the future. That is because the risk of being refuted is directly related to the improbability of many variables, variables that no one can inspect and examine does not even want to subordinate.

Nowadays, the ethical effect is more present that ever in all the field, causing aspiration and collective practices in term of ethics. At the beginning of the 20th century it was stated that morality refers to the whole character of the man, thus representing all the human action, the moral and the social aspects considering being almost identical.

But, the 20th century is characterized by mistrust in ethics and morality, postmodernist thinking "has caused the existence of any standards, principle and moral values with claims of universality". [9] But, the end of this century, ethics is brought to the forefront by more and more ethical debates, gaining a global reach, Gilles Lipovetsky affirm that "The 21st century will be ethical or not at all". [10]

With the risk of repeating ourselves, what matters most is its practical value for the present, and less the recognition of some prognostic merits that it could reclaim.

4. CONCLUSIONS

The political lie is very often present in political programs, electoral campaigns and even in government programs. For example, the story of "The Contract with Romania", the one released by CDR leaders during the election campaign from 1996, became very shortly after the elections a cause of mistrust against the governors. Later on, to these promises that have proved to be false, the same governments did not hesitate to add other bold terms to Romania's EU accession process, the future on their side once again. They relied, as always on the fact that the population is in a blur and not very well informed in regard to what it can mean for it the entry into the EU. Thus, it is insinuated that getting out of poverty is no longer exclusively in the hands of the Government, but depends on the decisions taken in Brussels, and thus the sacrifices made in this regard are less visible internally. It was sufficient to announce the invitation of Romania to the negotiations of admittance that took place in Helsinki, so that the circumstance could be presented as a historical moment and a succession of a long-step process worthy of the internal sacrifice.

Currently, exceptions are the electoral programs, regarded with limited trust even by their authors. Very few are the ones who venture to develop extremely optimistic scenarios to eradicate the existing economic reduction, in order to avoid future embarrassing situations, when they could prove to be as false as is possible.

At least, for the upcoming campaign, they could be a barrier difficult to overcome in regard to obtain a new government mandate.

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CONTEMPORARY TRENDS REGARDING THE EDUCATIONAL CHANGES AND THE SCHOOL MANAGERS' ATTITUDES IN ROMANIA

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Abstract: *In the Romanian educational system, educational reforms were not easy to implement. It involved a chain of operations and restructuring, adaptation and training processes, in accordance with the nowadays demands of the educational system. This study highlights a diagnosis, a critical reflection, a reconsideration of the socio-educational realities. We emphasize that there is a conditioning reciprocal relationship between the change and the human resource's attitude and motivation in the educational system. The study results highlight the importance of personality development, school managers' capacity to analyze the process of change and to design and implement changes in the school organization. We demonstrated, using scientific methods of investigation, on a representative sample that the change and development of the school organization can be possible only if its people have valid reasons to operate the change at an educational level.*

Keywords: *change; education; education system*

1. INTRODUCTION

During the last three decades, the education systems in Romania were subjected to a succession of diverging reform proposals, going over a significant restructuring process.

The nowadays reformatory process in the educational institutions implies restructuring and conceptualizing the medium and long term strategies. All changes must materialize at the school level and should be transposed into an educational reality. In these conditions, efficiency and competence are fundamental issues; the education system must comply with the European standards of efficiency, competence and quality.

The educational reforms in the education system in Romania are addressed and equally affect the school organization and its members. Starting from the reality of the past few years, we can say that school organizations have shown a great capacity for adaptation. The observations made on reforms / changes in the pre-university education system highlight that in the early stages of the first educational reforms were registered times of crisis, and then, through a process of transposing into practice the reform measures, the members of school organizations have adopted a collective learning process that allowed adapting and implementing change strategies.

In order to meet this goal we have achieved an objective assessment of the impact, the effectiveness and efficiency of several activities in relation to their objectives.

2. CHALLENGES FOR SCHOOL MANAGERS'

After being part of the European Union, the Romanian educational system adheres to school quality, in which the satisfaction of direct and indirect beneficiaries is the main objective (National Reform Program, 2011-2013; http://www.edu.ro; OMECTS 6194 , 13.11.2012, art.1 al. 2). In the wake of the observations made in the study, we emphasize that the cooperation of all actors involved is still necessary, so as to achieve a modern, coherent and unitary system. It is still necessary that training in the Romanian society adapts teaching to the needs of the modern society and focuses on the individual's educational needs and training, so as to be able to adapt and anticipate the pace of the society and the future will no longer be a surprise. The agents who participated in the training program "Education for Change" have realized that in the contemporary social context, where information and knowledge are the main factors of development, the educational system will make a prospective effort of development and school will be responsible for developing knowledge. "Knowledge is the power of both mind and directed action, and school is the main institution of transmission / reproduction of knowledge and thereby the distribution of power in society" (Fr.Bacon, 2002, p.29, Vlasceanu L (coord.) 2002, p.29).

The training program "Education for Change" where school managers took part in targeted the development of analyzing and interpreting skills regarding the phenomenon of educational change, as well as improving the attitudes towards reforms. The goal was to convince school managers of their ability to apply and control the process of change and make them promote the change / educational reforms. We focused on the future educational changes content investigating the availability or constraints which argues the attitude and determines or not the resistance to change, or acceptance of the educational reforms. The formative educational approach to change was based on:

1. Creating a cognitive structure;
2. Creating an attitudinal and motivational structure in order to determine the acceptance and change implementation;
3. Creating an action structure (behavioural) by designing a strategy to promote the educational change and the school management tools, as well as a coherent implementation and promotion of the changes and a self-evaluation of the need for change in the school.

I affirm that I have managed to achieve the overall objective, i.e. evaluating the capacity to change at an individual and group level, the development opportunity in a climate of satisfaction, contentment and professional fulfillment.

Analyzing school managers' category, I affirm that I have managed to get them set organizational goals that meet the objectives of school organization members, so that everyone involved be engaged in fulfilling the objectives and promoting change. It is worth mentioning that the assertive attitude towards change was due to the challenge of change and motivation in this direction, favoring communication, persuading educators to analyze and debate the reforms that have to be implemented.

I have found that in the early stage of the change process, those involved were unbalanced and only afterwards they formed their knowledge, pro-change attitudes and skills, so the balance is regained (Bargh, J.A., Chaiken, S., Govender, R. si Pratto, F.1992).

The study data show similar conservative trends towards change from the school managers' part, accepting the change only declaratively.

The study highlights the exponential growth of the management team's interest after the training program. They have managed to make diagnosis, projects and plans to implement programs in order to development the institution.

The decentralization reform of the pre-university education system is the one that changes the role of the school manager, which is totally different from the old management practices. Nevertheless, there are still many school managers that need to acquire new competences and specific skills regarding organizational leadership.

The manager has the role of operationalizing and implementing the change as well as managing the educational reforms in all dimensions of school organization, as effective as possible.

Because of the many changes in education and nowadays society, the manager has to plan the future of the school organization and anticipate possible changes. The previous experiences in management are insufficient and I even dare to say that they may hinder the change. A very important aspect is the manager's ability to analyze the process of change from different points of view, so as to have access to a change in management. To reach this goal, the manager must work on the awareness, identification and prioritization of the main levers so as to implement changes and educational reforms quickly and efficiently.

A part from management skills, which he can develop through professionalization programs, the manager must also use organizational development strategies and should always be concerned about the diagnosis of the institution. This diagnosis must cover both the internal and external environment of schools according to the European standards.

According to another observation of the survey, the current managers must combat the stress caused by the change by promoting pro-change attitudes, or developing affective-motivational and volition aspects as well as empowering all the beneficiaries of educational change. It is important to stress here the need for frequent and responsible analysis and diagnosis regarding the need for change, both at an organizational and individual level.

3. RECOMMANDATIONS AND CONCLUSION

We recommend a formative step in this direction both at the individual and organizational level so that the main objective should be developing individuals' personality as well as the school organization. Educational strategies must be diverse and should involve both organizational development and personnel development strategies so as to facilitate a correct assimilation leading to change.

Among the most effective strategies that should be promoted nowadays are the innovative, proactive and participatory strategies that involve both the individuals and the organization in transposing the reform into concrete actions and promote reform measures effectively. These strategies need to be updated and adapted to the needs of the school organization and the individual members of that organization but also according to the particularities of the school as an organization.

In conclusion, the educational change through the current reforms, recommends the school managers to provide professional management in the educational institution that s/he leads and to raise the awareness of all educators in order to promote the change, because it is the only way to respond to society's demand.

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VALUING THE EDUCATIONAL CHANGES IN THE ROMANIAN EDUCATIONAL SYSTEM

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Abstract: *This research aims to provide an insight into the level of assumption regarding the responsibility of implementing and promoting the educational changes in the Romanian educational system. The diagnosis highlights the need to build an organizational identity, the need for professionalizing the human resources and the orientation towards social values. This research was conducted on a representative sample of teachers in the pre-university education system in the South-East of Romania. It allowed an analysis of the changing phenomenon (of the educational reforms) using scientific methods to obtain information regarding the attitude of the human resource in the educational system towards the educational reform dimensions. This strategy can be considered a support to make the leap to an active portance against educational changes. The respondents realized that, in order to put into practice this goal, the school must activate its mechanisms of strategic management which are meant to lead the educational actors towards a continuously engagement in the development and reconstruction process of school and professionalizing the teaching career.*

Keywords: *education; diagnosis; school; reforms.*

1. INTRODUCTION

Since 1989, in response to the new challenges of a developing society, the educational system in Romania has gone through many reforms that have affected and changed different fields of activity. During this period, in Romania, the need for freedom of thought and the expression of specific rights of a democratic society were shown. These aspects and the ability to quickly adapt to new and change have led to the implementation of a set of reforms in the educational system; this change leading to the Romanian progress in the modern society. The change implied a chain of restructuring and adapting operations, of forming prospective and proactive skills according to the new educational system (Cool T.D., Shadish W.R, 2008, 27).

In the wake of the conducted study on a representative sample representing the human resources in the system (teachers, school managers, school inspectors, and students) we can specify that the educational change took place over a period of time, after a regeneration of the mission and practices in schools. It is worth mentioning that diagnoses have to be done in order to determine a reconsideration of the socio-educational relations.

Analyzing the dynamic of implementing the educational changes, as well as the educational resources' attitude towards this process, we need to emphasize that we found that the educational change is much faster if it is done from the inside out. Thus, the educational actors were directly involved in the teaching career professionalization plan as well as in perfecting the school organization.

Furthermore, the motivation for change was accepted much easier because the respondents acknowledged the need to change, seeing it as a real potential for development.

2. A MODEL FOR VALUING THE EDUCATIONAL CHANGES

The current guidelines for educational reform focus on (National Reform Program, 2011-2013; OMECTS 6194, 13.11.2012, art.1 al. 2):

1. Compatibility of schooling cycles, modern educational requirements and European Qualifications Framework.

At this level, the school education structure was reorganized comprising: ECD (0-3 years, ante preschool); preschool (3-6 years); the introduction of preparatory class in the primary education; increasing the duration of secondary education to 5 years by introducing preparatory class, whose role is to provide children a year to help them make the transition gradually, in an organized context, from pre-primary or exclusive family life to school; generalizing the 12 form schooling, and increasing the duration of secondary education to 5 years (grades V-IX). All these changes provide continuous, unified and coherent learning pathways.

2. Curriculum modernization and decongestion.

This main focus is on improving the curricula. Education Law introduced a curriculum based on the 8 key competences that every individual needs for personal development, active citizenship, social inclusion and entering the labor market.

3. Reorganization of student assessment.

The main changes to this level are: the introduction of educational portfolio (diplomas, certificates) and modifications regarding students' assessment (assessment at the end of the preparatory form and at the end of the second, fourth, sixth and ninth form).

4. Ensuring a higher degree of decentralization, accountability and financing within the system. It implied a transfer of responsibility towards the managing board of the schools and local authorities.

5. Providing equal opportunities to education for disadvantaged groups. Upgrading technical and vocational education. The aim was to implement programs like "School after school", "Second Chance", so as to equal the access to education and keep at-risk students at school, and prevent early school leaving by attracting them.

6. Reform policies in the human resource field

It was proposed the re-establishment of vocational schools, upper secondary education with technological profile, financing some training programs for those who have interrupted their studies, allowing the acquisition of appropriate qualifications according to the National Qualifications Framework.

7. Fostering lifelong learning

Lifelong Learning Centres were set up by the local authorities to implement community-based policies and strategies in the field of lifelong learning.

At present, an intense acceleration of school education reforms was determined in the pre-university educational system.

Strategic objectives set by "Europe 2020" (http://www.edu.ro) strategy, requires a high level in terms of the education system quality, chartering to human resources in the education system the change contents providing support, resources and strategies for change.

The study highlights the willingness for change of the respondents who had prior training through proactive skills development and the capacity to adapt to new. The study led to the knowledge of teachers' attitudes, representations and expectations.

During the training program, teachers have solved their socio-cognitive conflicts, have cultivated their adaptive and development capacity, knowledge acquisitions, skills, and have formed favourable attitudes towards change.

The training program counted 240 hours. In the first phase, we found that the attitudes towards educational reform were contradictory or ambivalent. We can say that this ambivalence was present because of the prejudices, beliefs and expectations. To overcome this imbalance and to develop assertive attitude towards change, we determined teachers to realize the need for change and motivational strategies to facilitate the change implementation. Afterwards, we made a comparative analysis of the change referring to the old practices in order to clarify whether the new changes are superior to the old ones. All these allowed the evaluation of changes in relation to performance and efficiency criteria.

Analyzing teachers' availability in promoting the change, I deduced the attitude and valence ascribable to change, and made predictions regarding the involvement in promoting the change. I deduced that the basic condition of motivational strategies leading to the involvement in promoting the educational change is the extent to which teachers perceive it as a possible development both personal and professional.

Therefore, the awareness of the necessity of change and forming proactive and prospective attitudes can be achieved if it creates a cognitive structure based on the informative side. Thus, the individuals involved in this process form their representations, notions and beliefs regarding the educational change. This is the first step to make them understand the importance and need for educational change.

I have demonstrated that it will reach the conduct if the informal translates into internal motives that will generate affective experiences and attitudes. There will always be a close connection between the cognitive and the affective. The triggered attitudes are: attitudes of acceptance, rejection or ambivalent attitudes. Analyzing the training path for change of the respondents who have participated in this study, I dare to say that the resistance to change can have as a starting point the informal side quality. In our case, this refers to not knowing the change issues and mechanisms or misunderstanding the necessity for change (Alice H., Eagly, A.H. şi Chaiken, S.1993).

Another aspect to be accessed refers to making the respondents overcome some obstacles or misleading representations about new practices (Abelson, R.P.1995). From the observations made, I claim that, at the beginning, a large number of respondents accepted only in theory certain techniques and reforms. Another very important aspect that is worth mentioning, in terms of change, refers to the existence of an "individual cycle of change" (S. Iosifescu 2000, 23). The differences are significant, differing from one teacher to another.

Therefore, implementing the change is possible if mentalities, prejudices and stereotypes are processed.

It is demonstrated that after this awareness, positive attitude and even ambivalent (bipolar) action, the pro-change conduct can be possible. As a result, we can speak of a participatory, proactive and forward-looking attitude.

3. CONCLUSION

The education program for change must be a formative approach, containing an informative side, and long-life forming, so as to realize the advantages, to overcome the outdated mentalities, prejudices and stereotypes in thinking.

Thus, one can purchase the concepts leading to change in a right way, so as the new practices be learnt and form prospective and proactive competences as a proper response to the imperative needs of a modern society.

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THE IMPORTANCE OF THE PARTNERSHIP FAMILY-KINDERGARTEN-COUNSELOR IN PREPARING PRESCHOOL CHILDREN

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Abstract: *This paper presents a synthesis on the psycho-pedagogical premises of children's preparation for school. It presents the framework of the informational content of the knowledge that a child has to possess at the entrance to the school, as well as the most important, instructive-educational functions of the education. At the same time, it offers the possibility of improving acceleration adaptability to school request.*

Systems of concrete measures to prevent, reduce and avoid school adaptation difficulties can be helpful in educating children, kindergartens or schools to ensure school success and prevent the persistence of some of the difficulties that may arise in the process education.

The present paper tries to provide theoretical and practical information useful in the work with children, carried out both in institutions - under the leadership of teachers and in the family under the guidance of parents.

The adaptation of the child to the educational process, to the new living conditions, to the physical and social environment of the school is an imperative psycho-pedagogical and medical-social requirement necessary to maintain and improve morpho-functional, psycho-moral and social integrity of the pupil. It is important for each school teacher to quickly and easily adapt to the new requirements, to comply with them without bio-psycho-social disturbance. The way in which adaptation to the requirements of everyday life takes place can be felt, both positively and reversely, over the years.

Keywords: *kindergarten, adaptation, school immaturity, didactic game, evaluation criteria.*

1. INTRODUCTION

School adaptation is a process of achieving a balance between the evolving personality of the student during his multilateral training and the upward exigencies of the entourage, given the assimilation of informational content according to his / her own availability.The child's preparation for school adaptation still begins in the family, being continued in crèches, kindergartens frequented before the school period. However, during this period only the fundamental milestones of the adaptation are established, as they are complemented and gradually deepened in the following years of professional development

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The child's preparation for school adaptation still begins in the family, being continued in daycare, kindergartens frequented before the school period.

However, during this period only the fundamental milestones of the adaptation are established, as they are complemented and gradually deepened in the following years of professional development.

The preparation of children for school must be conceived in close connection with the psychogenetic principle of development, without minimizing the biological and the social one, through which the child's multilateral and harmonious development is possible. Optimal school adaptation therefore depends on the general and harmonious development of all aspects of personality. Through creative and creative activities, the child learns to perceive, understand, think, evaluate, make decisions, and act. A child fit for school must have a correct and expressive speech so that it can correctly express its thoughts, desires, intentions and emotional feelings, verbalize correctly what it wants to communicate to others, using the correct lexical and grammatical use of words

The emphasis is on pre-school development on the development of the training dimension, because not acquiring a large amount of knowledge makes the child fit for school, but also the acquisition of some of the skills, abilities and intellectual operations necessary for the act of learning that favors learning. Preschool education is meant to offer children a sum of learning experiences that will make it easier for them to integrate into primary education.

In the current context, characterized by a transition to new structures and content, pre-school education is also covered by the current of change. This attitude change refers to a greater freedom for the child and its ability to express, and its development is viewed from the perspective of the support it is given to fulfill its needs.

The positive attitude towards school and the success of the child's education are greatly influenced by the climate that is being established in the family.

Thus, the optimal school adaptation or any difficulties that may arise during schooling may often reveal some of the deficient issues in the pre-school years, or predict the evolution of future adaptation, the way in which the duties towards the family will be satisfied, the place work and society.

The purpose of the paper:

This study aims to contribute to the delineation of specific symptoms and differential difficulties encountered in adapting school.

Research objectives:

The aim of the paper is to study the way in which attendance of the kindergarten more than two years has an important role in adapting the child to the requirements of the first grade, so the child will better meet the requirements of writing, reading, reckoning.

Research hypotheses:

1. Children who have attended the kindergarten (more than 2 years) have better perceptive-motor function compared to those who have not attended it for at least 1 year. They respect the principles of Gestalt, being able to play without difficulty so simple geometric elements (line, point) and complex geometric elements (circle, square, etc.)
2. Children who attend kindergarten (over two years) have a well-developed vocabulary and can render the test phase words (proven Rey minutes) than those who did not attend kindergarten at all or only one year.

3. Parenting style (permissive, directives), organization of the environment (divorced families, normal families from the point of view of relations between their members) contributes to the optimal adaptation of the child to the requirements of the first class or, on the contrary, can lead to the child's inadequacy in school life.

2. ORGANIZATION AND RESEARCH

In order to achieve the proposed objective, we used two experimental groups: the first group consists of 14 children who attended the kindergarten for more than 2 years (group A), and the second group consists of 14 children who attended the kindergarten at least 2 years or not (group B). The children in both groups were randomly chosen from the first grade students from School no. 30 Braşov. Samples were applied in the first week of the school year, so that the school activity did not influence the results.

The **working tools** we used to test the hypothesis and achieve the goals we proposed were as follows:

- systematic observation (observation sheets);
- formative pedagogical experiment;
- analysis of the products of the activity;
- knowledge tests;
- sociometric techniques.

To test and measure the hypotheses we developed, we used the following tests: Rey verbal memory test;

- Bender-Gestalt test;
- Raven Color matrix-progressive .

The ***Rey Verbal Memory Test*** aims to determine the volume of verbal memory (ML), reproduction quality, attentional resource engagement and effort resistance.

The test has three phases of information processing:

- The *Input processing* phase includes: perception of verbal stimuli, sequential attention, the use of overriding concepts that can influence discrimination and storage, the level of depth of information processing.

- The *Elaboration phase* aims at: using the concepts necessary for storing information, establishing the relationships between the stimuli, differentiating the stimulus, keeping the stimuli until their updating.

- The *Output processing phase* is aimed at: verbal stimulation of stimuli, activity control, impulsivity.

The sample contains a total of 15 words and a related story. It is carried out in six phases, the first five aiming at reproduction in the form of reproduction, and the sixth in the form of recognition.

The Bender Gestalt Test, developed in 1938 by Lauretta Bender, consists of 9 test planes, each geometrically drawn on each slab. These nine figures, along with others, were used by Wertheimer in his experimental studies on the perception of how the

principles of gestational psychology can be applied to perceptual processes. Lauretta Bender selects 9 of the configurations used by Wertheimer, which she incorporates into a test - Bender Gestalt Test / Video Gestalt Test - which evaluates the level of motor perceptual development.

In children, the Bender test was used for extremely varied purposes: to highlight school maturity as a predictive indicator of school success, diagnosis of learning disorders and learning disorders, identifying emotional disturbances, diagnosing brain injuries, studying children mentally retarded in the differential diagnosis of children with psychiatric disorders and delinquents, as well as the intelligence test.

The Raven Progressive Matrices are described by J.C.Raven as "Perceptual and Thoughtful Tests". Each problem of the scale is a "source" of a system of thinking, while the order in which the problems are presented provides a training in the operating mode.

There are three forms of Progressive Matrices: Standard, Color, and Advanced.

- Progressive Colored Matrices (MPC) comprise three sets of problems: A, B, and Ab. The Ab set was designed to accurately investigate the intellectual processes of children, mentally retarded and elderly people. The color presentation of the test captures the attention, it spontaneously becomes more interesting and avoids the use of too many verbal instructions.

– Progressive Color Matrices are designed to evaluate intelligence in young children (under 14 years) in the elderly for clinical purposes. The MPC is intended to assess the clarity of observation capacity as well as the level of intellectual development of children.

Based on experimental studies, J.C.Raven identifies 5 stages to solve:

- The child is able to distinguish identical figures from different ones, and then those similar to unlike ones.
- The child is able to appreciate correctly the orientation of the figure both in relation to his / her own person and to objects in the perceptual field.
- The child is able to perceive the whole.
- The child is able to analyze the elements, the characteristics of the perceived whole, and to distinguish between what is included in the matrix and what it has to find itself.
- The child is able to compare similar changes in the perceived characteristics and adopt the analogy as a way of reasoning.

3. PROCESSING AND INTERPRETATION OF RESEARCH RESULTS

1. The results obtained by applying the Rey verbal memory test to children's group A are as follows: 5 children have poor performance in terms of working memory (ML), 6 children have a medium performance in terms of ML and 3 children have a very good ML performance. In group B, the results are slightly different: 6 children have poor ML performance, 4 children have an average ML performance and 4 children have a very good ML performance.

2. By applying the Bender Gestalt test, we aimed to assess the level of development of the perceptual-motor function of children from the two groups. The results obtained were ranked on three levels of performance: weak, medium and well developed.

3. Thus, in the case of group A, 4 subjects have a poor development of perceptual-motor function, 7 subjects have medium developed perceptive-motor function and 3 subjects have well-developed perceptive-motor function. In group B, 9 subjects have a poor development of perceptual-motor function and 5 subjects are medically developed in terms of perceptual-motor function. No subject in this group has demonstrated a good development of visual-motor function. Using MPC, we aimed to assess the clarity of the observation capacity and the level of intellectual development of children in the first grade.

The results of the test were classified into 5 levels:

- above the median (2 subjects in group A and 2 subjects in group B);
- upper median (5 subjects in group A and 2 subjects in group B);
- lower average (6 subjects in group A and 7 subjects in group B);
- under-average intelligence (1 subject in group A and 2 subjects in group B);
- Limit intelligence (1 subject in group B).

3. Counseling plan for adapting the child to school life

Program duration: 11 weeks with a frequency of activities of maximum 30 min 2 times per week;

The basic approach: if children learn at an early age to develop their repertoire of coping abilities, they will develop fewer problems in childhood, adolescence and even maturity when they face inevitable stressful situations

Discussions do not tell the children what to do; they are not told that a solution is good or bad, but children are encouraged to research and think for themselves, communicate their feelings, make friends, cope with rejection and loneliness, solve conflicts, use different strategies coping.

Program Components:

- Emotions - Goal: Improve children's abilities to recognize difficult emotions and identify coping strategies for these emotions.Comunicare - scopul: Îmbunătăţirea abilităţilor copiilor de a-şi comunica sentimentele.
- Snapping and breaking relationships - the goal: Improving children's abilities to make friends and deal with rejection and loneliness.
- Conflict Resolution - Goal: Enhance Conflict Resolution Skills.
- Facing change and loss - the goal: Improving children's abilities to cope with change and loss.
- We meet - aim: Improve children's abilities to use different coping strategies.

4. Individualized intervention programs for student adaptation to school tasks

4. CONCLUSIONS

Analyzing the children's results in the applied tests, it is possible to demonstrate the decisive role of the kindergarten in their preparation for the school. Thus, those who have attended the kindergarten for more than 2 years have better perceptive-motor function. This will facilitate the development of sensory processes and representations throughout the school year. Observing this category of children along Class I, we found a broadening of the field of vision, an increase in precision in color differentiation. Progress is made on the ability to receive high sounds and the ability to self-control their own voices.

Perception has gained new dimensions. Sincretism begins to diminish, due to the increasing perceptual acuity for the components of the perceived object.

Children who attended the kindergarten can easily render simple or complex geometric elements. Upon entering the school, the child has many representations about household objects, fruits, trees, animals, the surrounding people, and their actions and activities. However, his representations are still merged, confused, less systematized. Under the action of learning, however, representations undergo essential changes, both in terms of sphere and content, and in terms of how to produce and operate.

The child uses freely, voluntarily (in drawings, stories) the pool of representations he has come from the kindergarten, including them in new combinations, creating new images. Representation will serve to realize the processes of imagination, thinking and various forms of creative activity.

Significant progress made children thinking processes - appear reinforce logical constructions. These take the form of judgment and reasoning which allow the child to discern certain permanent certain invariants such as the amount of material, weight, volume, time, speed, capacity. Develop thinking operations absolutely indispensable to any intellectual activity: analysis, synthesis, comparison, abstraction, generalization, calsificarea concretisation logic. Thinking becomes more productive, as a result of increasing the degree of flexibility and mobility, of using different mental processes.

Upon entering the school, the child has a relatively rich vocabulary and mastered in practical rules of correct use of words in speech.

In the small school is developing both oral language and the written word. Regarding oral language, one side is important to conduct listening. The child who listens more carefully attended kindergarten teacher explanations and walk "in the footsteps" of his advice and reasoning in solving arithmetic problems.

In the context of other school activities, work, drawing, physical education, nature observation, the former pre-set tasks solved easily.

The children who attended the kindergarten acquire much faster the reading, the writing, the reckoning, because in the pre-school the phonetic side of the language develops, although due to the particularities of the fonator, the verbal-motor analyzer and the auditory analyzer, the pronunciation is still not perfect.

The volume of memory increases considerably. The child memorizes and retains data about the signs and symbols with which they operate, about the rules they learn, about the objects, the animals they come into contact with. Due to the cooperation of memory with thinking, the logical, logical forms of memory, based on the links between the data, are installed and developed. Analyzing test results Rey verbal memory, I noticed some children who attend kindergarten, a memory and a reproduction of their words by their semantic value. In others, a reproduction of words beginning with the end of the list (especially in phases 4 and 5) was observed, indicating a mechanical memory. False words did not appear in significant numbers, and double words (said by some) indicate the tendency of subjects to say all they know. The focus of logical memory increases the volume of memory in school, pre-school, prolongs retention time, increases the liveliness and productivity of menses.

Entry into school creates new imaginative features and requirements. Reproductive imagery is highly demanded, and the child is often in a position to reconstitute the image of realities he has never known.

Entry into school creates new imaginative features and requirements. Reproductive imagery is highly demanded, and the child is often in a position to reconstitute the image of realities he has never known.

The status of schoolchildren means that at this age, the child is given a new position, both within the family and among the other children, characterized by distinct external meanings and social meanings.

The child comes in contact with requirements and norms of conduct which in a way disagree with the perpetuation of some affective particularities of the pre-school age: the tendency to achieve at any moment some temptations of moment, the immediate, spontaneous, often capricious and uncontrollable experiences .

School and school environment represent a new community for the child, which often fills him with anxiety, making him frenzied with the thrill of contact with the unexpected. Changing the way of life, the new regime of activity, causes a lot of worries and troubles to the little school, making it feel full of the deep meaning of the new "step" in life. Gradually, anxiety spreads, appearing more and more appropriate adaptation processes.

Emotions and aesthetic feelings are closely related at this age to both the contemplative moments of artistic "objects" (paintings, poems, stories) as well as the active participation of the child in artistic creation.

Especially at the beginning of the school, the teacher has to act in the direction of cultivating the ability to master the primary, explosive emotional manifestations of the children. He also has to deal with cases of delay or emotional deviation, malicious manifestations, affective insensitivity of some, lack of affective co-participation of others. Children must be supported in order to understand and to correctly understand the content of the notions and norms underlying moral feelings. It is necessary to explain them at their level of understanding by resorting to practical life situations, which means morally and evil, beauty and truth, courage and cowardice, honesty and dishonesty.

The role of the kindergarten and the child's family is crucial in adapting the child to school activity. The child who comes from a normal, warm family environment, in which interpersonal relationships are based on quietness, friendship, understanding, helpfulness, will integrate very easily into the collectivity of the school.

For success to be fully guaranteed, there is a need for permanent links between the family, the kindergarten and the school, the center of interest of the three sides being the child. A good adaptation to school life will have major implications throughout schooling, and later in social life.

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EDUCATIONAL RELATIONS AND INTERACTIONS IN THE STUDENTS CLASS

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Abstract: *The present project is an attempt to investigate the extent to which socio-emotional relationships within the classroom can contribute to optimizing its cohesion. Interesting is the knowledge of the cognitive and socio-emotional potential of the known students being the fact that any educational activity is based on the psychological knowledge of subjects who are subject to such intervention.*

The process of socialization begins during childhood when the first social contacts and life experiences take place throughout life, as the individual acquires new statuses and roles.

Socialization is realized as individualization - socialization - personalization, processes that are in close connection and have different rhythms. If, in primary socialization, a process of individualization is predominantly carried out, the child learning his uniqueness of being distinct from other human beings, through socialization of the school type, the child builds a social identity, following a very complex process that does not exclude manifestations individualization.

Child in school assumes the role of a new form of social adjustment reflecting the extent that it fails to meet the program requirements regarding the conduct and the accumulation of knowledge.

The teacher has the mission to encourage the students' spontaneity, showing creativity, openness and flexibility. The group gives the pupil an ideal of self, a soothing image of my own. Only the group can fulfill its valences of affirmation, it can give it a sense of value, strongly shaken otherwise.

Children who learn together learn to live together.

Keywords: *socio-emotional relationships, social group, optimization of cohesion.*

1. INTRODUCTION

When classmates have the feeling that they are a small community ("family"), they are more likely to work to carry out work tasks, enthusiastically participate in class activities, and plan to reach levels high training. Such a feeling is associated, moreover, with a decrease in the frequency of indiscriminate, violent behaviors. It is the feeling of the conviction that all of us share the same duties, respect and support each other in what they have to do, and I think each of them contributes to what is learned in the classroom. The cohesiveness of a class of students expresses the extent to which its members are willing to give up some of their gratifications, opinions and personal conduct in favor of the group as a whole. It involves awareness that the actions and behaviors of each member have direct or indirect consequences, manifest or latent, for everyone else. Maintaining group unity requires that each class member assigns a certain priority to the group as a whole beyond their own desires, attitudes and opinions.

Class cohesion depends on the extent to which the group has unitary objectives, possesses a set of values and norms that regulate members' conduct according to the group, has a unitary leadership in achieving common goals, and members assume mutually grateful roles. Otherwise, group life is dysfunctional, because dissensions, conflicts can arise, and participation in the group's activities is relieved of any satisfaction.

The main characteristics of the strategies adopted by teachers to create this sense of cohesion for a class of students are related to:

- creating a climate in which students are convinced that they can express their opinions and feelings openly and honestly; the teacher will systematically ask them to express their ideas and opinions, which they will incorporate into class discussions and activities;
- creating mechanisms by which students can help the classroom perform well (for example, entrusting role-playing roles to colleagues); promoting social values favorable to cooperation, fair sharing of tasks; creating opportunities for classroom students to help each other (for example, asking "Who has a problem and thinks someone else in our class might help him solve it?");
- the recognition and public mentioning of those who have contributed - little or no - to the successful defragmentation of some class activities.

Research objectives and motivation for choosing this theme

Through this research, the importance of the socio-emotional relationship within the pupils class and its importance in optimizing its cohesion is seen, this relationship is a very complex educational and social phenomenon that will not cease to assert its difficulties, offering everyone a horizon unlimited study and knowledge.

The research pursued was:

1. the socio-emotional relationship within the pupils class;
2. level of class cohesion;
3. interinfluence of these two variables.

Research hypotheses:

1. If the class has a high level of socio-emotional relationships, it affects the optimization of its cohesion;
2. If the class has a high level of cohesion based on interpersonal relationships, then the class has a high level of cohesion based on task execution;
3. The more students appreciate their performance at a high level, the more they appreciate the high performance of the class.

2. RESEARCH METHODOLOGY

Discussions were held with teaching staff teaching in the class of students undergoing research, and a questionnaire was applied to them to observe students' attitudes during classroom sessions, the relationship between pupils and its effect on the instructive-educational process.

The school documents (psycho-pedagogical papers, characterizations, student portfolios) as well as evaluation sheets and school results obtained in the previous school year were consulted.

Methods and techniques used in research

Considering the children 's personal data, the school catalogs, the enrollment sheets and the psycho - pedagogical sheets drawn up by the class teachers, we achieved the influence of the school results on the socio - emotional relations within the classroom and implicitly on its cohesion.

The observation, the main method of direct investigation, manifests itself as a systematic act of careful follow-up of the educational process as a whole, or under its different sides, aspects, situations, without making any changes from the researcher. It has a concluding character of educational diagnosis. The data obtained is recorded as accurately as possible in a special notebook, called the observation log (protocol).

We used the observation method at all times of research. Initially, it was global in nature, being the starting point that gave me the opportunity to catch up with the problems. Then she accompanied the experiments and contributed to verifying the hypotheses and confirming their justice in the instructive - educational practice. Using this method, we explored the facts and manifestations of psychic processes, emotional expressions, and the environment in which students work.

The conversation is the method of direct research that deliberately discusses with subjects and educational factors for obtaining data about the conduct of the instructive-educational process. It takes the form of dialogue-interviewing or in the form of discussions (debates). The discussion between the researcher and the subjects must be based on mutual trust. Such a conversation offers good conditions for obtaining real, unmodified data on the educational aspect we are concerned with. In order to avoid subjectivity, it is necessary to have dialogue with as many subjects as possible and to correlate the data with those obtained through other methods of pedagogical investigation.

Soiometric techniques are the set of tools and procedures designed to capture and measure the configuration and intensity of interpersonal relationships within the student group. Under this name are included both the material collection tools and the materials for processing and interpretation of this material.

These instruments include: sociometric tests, sociometric matrix, sociogram.

The sociometric test designed to provide primary information requires members of a group with well-defined limits (eg a class of students, a workforce, etc.) to indicate their colleagues with whom they would like to associate for a concrete action or in a future situation.

For example, in school: arranging or re-arranging children in banks, organizing groups of practical work, choosing a trip or traveling (neighborhood neighbors), sending an illustrated postcard or postcard (during the holiday, or being in the camp), choosing a responsible person, pointing friends or close colleagues in the classroom, appointing your favorite partners in the game, etc.

The test only provides raw material about the relationship between the student and the group as a whole. Subsequently, this material will be processed and only on the basis of those results we will know these aspects.

A sociometric test with 4 questions was used in this research asking students to indicate 3 names of colleagues for each question. These questions may have as a reference various aspects or areas of interest: leisure time, participation in school tasks, cooperation within the sports team, etc. At each given answer, motivation was also pursued because of these motivations the objective evaluation of the pupils can be achieved to some extent.

The sociometric test can be used in cross-sectional research to capture the evolution of collective relationships. Thus the test is to be administered periodically and the results obtained are compared to each other. It should be specified that repeating the test at too short intervals diminishes its effectiveness, subjects focusing more on previous responses that are still alive in memory than what they feel right now. Also, if the intervals are too high, we risk losing sight of the strict dependence of phenomena.

3. PROCESSING AND INTERPRETATION OF RESEARCH RESULTS

The mental state of each class student is more or less influenced by the socio-emotional climate in the class, which can lead to satisfaction or dissatisfaction, balance or conflict, efficiency or inefficiency.

In terms of the research groups, if in terms of intelligence, they had the same characteristics, there were many differences in terms of pupil participation in collective life and interest in learning. While in the control group 80% of the subjects were interested in the life of the team, they showed an initiative of particular concern for the school activity, they had two leaders whose actions positively influenced the whole class in the experimental group at the end of the first semester of the school year there were five shy children, 7 suffering from the "listening syndrome", half of the students learning the most necessary and a tense state due to the conflicts generated by the five pupils' attempts to become leaders.

In the questionnaires applied according to their purpose, the questions were grouped into several categories. Questionnaire no. 1 aimed to obtain indicative data on the children's concerns and the relations established between them, giving directly information about the structure of the school classes. Questionnaire no. 2 through this questionnaire was aimed at obtaining data about the pupil's family, who likes to spend his spare time if he is part of a sports team or circle highlighting the importance of social attitudes in developing friendship relations in class. In the questionnaire no. 3 extra-curricular concerns are noticed, what books and films they prefer, if they are more attached to school or family, of house. In Questionnaire 4, the emotional stability, the relationship of the student with the family (mother, father) and the relationship of this relationship with the behavior towards the classmates were followed.

The consequence we have here is the organization of concrete, varied moral exercises that allow the emergence of affective feelings, initially in the form of emotions, then by stabilizing them in the form of moral desictions (collegiality, friendship, love for learning and work).

Students are the judges of the teaching staff. They question the entire personality of the educator: language, exigency, understanding, level of information, teaching method but also clothing, physical posture, look, voice modulation.

For juniors, jokes, fun, joy are more appealing and more effective in the educational act, for even more difficult disciplines like mathematics can be enjoyable if the teacher sneaks a joke. The idea that "the teacher jokes" or "plays with us through mathematics" does not exclude authority, prestige, respect, but consolidates them, harmonizing together. At the same time, students will be eagerly and delighted to have such activities, will learn the subject matter with pleasure, and develop friendship relationships within the group of students.

However, the most effective way of pursuing and educating the affective universe of the student in his classes remains the study of school subjects and, within them, the lesson.

And as reading and writing has a particular weight in the training and education of pupils in small classes, it is natural for this discipline to make the greatest contribution to the development of students' affectivity.

The main value of the game lies in the fact that it makes the participating students directly interested in their own training. Introducing the game into the very structure of the lessons is also a means of preventing, removing fatigue, straining the effort of small school children.

To dynamify the classroom of students, to transform cognitive emotions into intellectual sentiments such as: intellectual wonder, the desire to discover, to create, in the formulation of problems are used both concrete materials and games involving all the students of the class trained on to a relationship of friendship, cooperation.

Through music (melotherapy) it impresses children from the early moments of entering school. Music produces strong and pleasant emotions to students, brings them together games and walks, fun, but also learning.

It has been noticed that in the behavior of class I students subjected to the analysis of this research, how they project the affective potential of the teacher by considering him as a central figure of the group, the unifying factor that mediates not only the intercommunication of the lesson but also the relations of recreation or even those outside the school. Obedient and disciplined, most of the pupils in the class have a conformist attitude, no initiative, no personal contributions, original lessons.

The requirements of the teacher are respected especially for sake and in the presence of the teacher. The intense affective color of relationships prevents the manifestation of critical spirit and independence.

It was intended to know the reasons for students of the class to meet the requirements of the teaching staff. So it has been noticed how students in this class are concerned about hierarchizing their colleagues, learning outcomes playing an important role at this age. Even if he is not a good college, the "good student" enjoys prestige.

The results of the investigations made at the 1st grade at the General School No. 13 Braşov place the relations between the colleagues at the level of a purely rational evaluation and less in the affective adherence.

The above were also revealed in the applied sociometric test. Thus, in the control group (fourth grade) we found the existence of two leaders, friendship, attraction among the students in the proportion of 75%, the coefficient of the coefficient being 0.42. In the experimental group, the boys class is divided into microgroups, many choices are undecided, there are only two reciprocal choices, so there is no group cohesion. The girls' class faces lighter problems, there are 7 reciprocal choices, but the low coefficient of 0.15 indicates that there is no welding between class members. Instead, in the 7th grade there is a strong group cohesion of 0.71.

After the implementation of an intensive program to improve tensions of affective nature among the pupils of the 1st grade (experimental group), the second test of the sociometric test was applied during the second semester of the school year.

If the first test applied to grade I pupils revealed small but gentle amalgamations, however, there can be no discussion of group cohesion. So there were two subgroups in the boys class, and there were still tensions because each group wanted to promote their leader, and in the girls' class, the Cohesion Index took a higher value - 0.22.

By comparing the sociograms of the elections with those of the rejections, it was found that the intensive program of improvement of the affective tensions existing in the first grade of the students gave the desired results.

In the course of time, it was observed that the experimental group experienced a real evolution, so the last test registered a coefficient of 0.33 in the class of boys and a 0.55 girls class. Instead, there is a slight change in the value of the Cohesion Index in the control group: from 0.42 (initial testing) to 0.40.

The ability of class I to integrate individual colleagues into the unifying category of the team overtakes over time another way to conceptually integrate his new social relationships, namely his belonging to the collective. It requires a certain practice of common activities in class so that each student understands that in the new reality he has entered he has to adapt, accept transformation, communicate with the other.

Non-integration into college, school failure in grade I is often caused precisely by the child's weight to achieve this relationship between himself and the colleague who overturns his egocentric orientation characteristic of the previous period. The child's effort to perform such restructuring is facilitated by the systematic interventions of the teacher.

Among the students in the first classes, integration into the group of colleagues relies heavily on the regulation of school activity during lessons. They are able to respond to requirements that make order in their behavior, little pupils feel a special pleasure when they succeed in following the rules presented by the teacher. The deviation of one of the students from what "teacher said" usually raises a disdainful astonishment from the class. Solidarity in covering up the wrongdoer is a rare phenomenon, as collective misconduct is committed with difficulty and without conscious, organized adherence.

It has been noticed that in friendly relations he is subordinated to this mentality of unconditional compliance with the requirements of the school authority, which directs, to a great extent, the approaches and separations of micro groups in the classroom.

There must be strong motivation for friendship - and at this age it is not the typical situation - to resist, if that friendship opposes the teacher.

Such attitudes often meet in pre-adolescents, the stage when conformist attitudes, stemming from the group's tendency and pressure to uniformity, remain the status of "good students" of official leaders. With the increasingly prominent interest of pupils in grades V-VIII to assert "emancipations", to distinguish themselves from others and to obtain a superior status in the collective.

Of these students eager to oppose the norms of school life are recruited informal preadolescent leaders who can be both very good students and weaker children - the problem of giving the educators work. In the first case, they do not disturb the hour, but they want their release from guardianship and restrictions to other areas of activity (free time, acquiring status in the family group, in the group of friends).

Thus, it was found that the 7th grade preadolescent has more critical spirit than the student in the first classes, having greater possibilities of organizing the "group" actions, emanating from the fascination that colors the preschool emotions in relation to the novelty of student life , is ready to be trained in small frauds (blown, copied, "chi" from the hours). Such manifestations are sometimes prestigious reasons for the preadolescent in front of the group of colleagues, satisfying those who participate in them because they give them the impression of independence, pride for the face of danger.

In some classes of students, solidarity also finds expression in acts directed against teachers.

Obtaining a good place in the class hierarchy, made in the function of learning performance, is often the only motivation of the students' work.

The formal student leader appears either as a result of his choice by class members or by his appointment by the teacher. He is in charge of the class, and the small classes also appear: responsible for cleanliness, discipline, floral care. In class there are functions that rotate each student: the "on duty" function.

The student leader lives more closely than the teacher, the pulse of the class and the requirements he issues can be accepted more easily than those directly coming from the teacher. However, the student leader lacks the experience of life and leadership.

The informal, unofficial, non-institutionalized leader is the result of the network of sociometric structures in the class, of the preferences in the sympathetic interpersonal relations between the students. As he does not exercise his power in the same way as the formal leader, contradictions may arise between the two. The informal leader can become more popular than the more formal and influential.

4. CONCLUSIONS

Currently, there is no doubt that scientific psychology offers teachers reach investigative methods cohesion classroom and the field functions affective-motivational, temperamental peculiarities, will and personality of character. But the methods of investigating the affective universe of students are very demanding in that they assume from the teacher a thorough training, rich practical experience, perseverance on the part of the student regarding the relationship with the student.

In this research we have pursued the analysis of the following aspects:

- the socio - emotional relationship in the class of students;
- level of class cohesion - interpersonal and load;
- interfluency of these two variables.

The advantage of sociograms is to provide a radiograph of the state of positive and negative relationships at some point, and may be radically different for another situation.

To know how the collective evolves: we are interested in how the group spontaneously structure, what are the unofficial relationships that appear in the group. From the group relationships scheme, you can also get insight into the isolated members of the class, those who are unable to adapt, the most affluent, or the less well-liked.

Knowledge of the stage reached in the formation of cohesion: calculating the cohesion index before an important stage for the group and at some distance after that stage showing the effectiveness of the steps taken. Calculating the index at different stages will reveal in which direction the group evolves: increases cohesion, stagnates the group or is in a regress.

Phenomena that can cause such changes are numerous, so it is advisable to periodically apply the sociometric test and implicitly compare the results and identify the factors that produced the changes.

The two instruments proposed in this paper can be a great help in knowing the socio - emotional fundamentals of a group, which usually escapes direct observation but in particular offers the possibility of an action, an intervention on the group, taking into account its organization to improve its functioning, to improve group cohesion, but also to reconstitute homogeneous teams.

Following the investigations, the students stated, overwhelmingly, that relations between students are characterized by friendship. This information reveals the existence of a high level of cohesion within the class of students.

The hypothesis regarding the inter-infiltration between the socio-emotional relationship of the class of students and the level of its cohesion has been confirmed. It has been found that there are friendships in the class, that students do not want to leave the class, nor do they want other colleagues to leave. They communicate on any subject, mobilize in school competitions, carry out extracurricular activities jointly, and help each other within the group. Their belonging to this class gives them feelings of gratitude and pride.

The teacher is also responsible for the affective tone of the students. The anger, the refusal, the envy of the students make it harder for co-operation within the classroom, even for the purpose of fulfilling certain educational tasks. It has been noticed that in the instructive - educational process it is necessary to permanently adapt the teacher to the requirements of the class of students. Permanent adaptation of the teacher's behavior to the pupil's personality and group sentiment is necessary not to make the child happy to stay at school, but to awaken his desire and willingness to respond through appropriate behavior to educational action.

By addressing a systematic, effective educational influence, acting on the basis of a methodological strategy, we can accelerate the socio-emotional maturation process in the pupils class, thus preventing and even eliminating the negative phenomena that could prevent the achievement of cohesion within the group students.

Finally, it can be argued that a factor that largely influences the cohesion of the group is the socio - emotional relationship inside the class of students.

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EDUCATIONAL EVALUATION AND EVALUATION OF SCHOOL PERFORMANCES RESULTS - FROM THEORY TO EDUCATIONAL PRACTICE

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***Abstract**: Estimation and evaluation are valuation acts that take place in all human activities and especially in education. What is happening today in education, as far as evaluation is concerned, is nothing new, because evaluations are made from ancient times. New are the measurement and assessment techniques elaborated more rigorously from the perspective of didactic science. Well integrated in the didactic approach, the evaluation cannot be achieved without being directly related to the objectives, which constitute the point of entry into the system and trigger a real reaction in the chain at the level of education process. At this level, it is the question of determining the quality of the approach undertaken by those involved. In fact, the anticipated objectives become, after the delivery of learning, criteria on the basis of which the quality of the partially completed process is assessed. From the point of view of formative education, the main components of the spectrum of pupils' school results are: attitudes and behaviors, skills and habits, qualification and knowledge. They must be complemented by aspects derived directly from the students' learning process and subjected to evaluation. Let us not forget that "the illiterate today is the one who does not know how to learn". As a result, if we do not build tools to evaluate this fundamental human capacity, we will not be able to fully prepare our student for life.*

***Keywords**: evaluation, school results, learning process, evaluation tools*

1. INTRODUCTION

In a changing educational system, the **assessment** (considered for the beginning in a global way) and **examination** (designating both the selection and the certification function) is a true geometric place of the various tendencies, decisions, ideas-force, surface or deep movements. The evaluation in school, seconded by the examination at different moments of the educational path, has a stake whose costs and impact have become increasingly visible and more important with the decision making of the educational policy specific to the real reform, ongoing in Romania in recent years.

In general, the term evaluation refers to a rigorous, careful review of an educational curriculum, program, institution, organizational variable or specific policy.

From an instructional perspective, assessment is a systematic process to determine the extent to which instructional objectives are reached, achieved by students.

The pragmatic approach of evaluation, which states that the practice of evaluation involves systematically collecting information about the activities, features and objectives of the programs to be used by certain professionals to reduce relativity, improve efficiency and make decisions about what these programs are doing or the realities they affect. This definition of evaluation emphasizes the systematic collection of information on a wide range of topics for use by certain specialists for a variety of purposes.

Educational assessment is the process of systematically collecting, oriented on targeted objectives, the specific data on the evolution and / or performance highlighted in the assessment situation, the contextual interpretation of these data, and the development of an integrating value judgment that can be used in various ways, pre-specified at the time of setting the purpose of the evaluation process.

This complex process has several dimensions or faces, which appear obvious at different times or when updating certain valences of the evaluation, thus:

• The technical dimension is visible in measurement as an appreciation of a feature, characteristic or behavior by reference to a clearly defined measurement scale

• The teleological dimension is essential for any evaluation process, which gains its right to exist only when it is clearly formulated its purpose, depending on it being then designed the objectives, selected the most appropriate procedures and techniques, built tools etc

• The axiological dimension is operative in the depth structure of the process: it is both the creation and assignment of values, contributing both ethically and deontologically to placement in a general human system to which the evaluation culture makes a specific contribution.

In this context, the English-language assurance term, from the Latin assidere ("sitting with someone to assist, assisting," but also "sitting in court, as judge, assistant") designates the action of appreciating Educational / school progress by appreciating a feature, feature or behavior observable in a particular situation or in a specified context.

This research aims to make a diagnosis of how traditional and alternative assessment methods are used in primary education. The purpose of this psycho -pedagogy is to identify the level of knowledge of the theory and practice of current school evaluation, how to integrate modern assessment methods and techniques into the actual reality of primary education and to identify the points of intervention and training in the field for teachers.

2. RESEARCH OBJECTIVES

- determining the general level of knowledge of the current issue of school assessment by teachers;
- establishing options for the assessment method used by teachers in current and summative assessments;
- analyzing teachers' attitude towards the objectivity of each type of sample evaluation.

The specific hypothesis is the main instrument of psycho-pedagogical research*: in primary school education, assessment is mainly done through written evidence, but there is not enough diversity in the way and purpose for which these tests are developed*

3. METHODS AND RESEARCH TOOLS

- Observation
- Conversation
- Questionnaire

The conversation must be organized, pursuing certain purposes, after a flexible deployment plan to keep it from getting information

Questionnaire

The questionnaire is one of the most used methods in quantitative psychosocial research. For this reason, it is necessary to distinguish between inventory or personality questionnaire, attitude measurement scales, tests etc.

The questionnaire was applied on a randomly selected sample of teachers participating in methodological teacher conventions, counseling boards, referral sessions and communications or other didactic activities. . A total of 68 teachers answered the questionnaire, but only the valid protocols (with the required mandatory identification completed and with answers according to the indications and complete) were selected for processing. Thus, the final sample counted 54 teachers (teachers only).

Data analysis

The data collected from the 54 selected protocols were systematized for each item.

Item no. 1

Which is the most commonly used evaluation method in your **current assessment**?

In the current assessment, a formative assessment accompanying the entire teaching process, organizing systematic checks among all pupils in all subjects, written tests are preferred, with 46.30% of the options, followed by the oral ones with 29.63% of the options. Practical and alternative tests are less useful. Practical evidence however has an acceptable percentage: 18.52%, but alternative methods of assessment (project, portfolio, investigation) are negligible in our opinion (only 5.56% of options).

Item no. 2

Which is the most commonly used evaluation method in your **summative assessment**?

In the summative assessment that usually takes place at the end of a longer period of training and determines the extent to which the proposed general goals (either attitudes or capabilities) have been achieved, comparing students with each other (normative interpretation), or by comparing the performance of each with the expected performances (the criterion interpretation), the written tests are preferable (with 37.04% of the options), but to a lesser extent than in the current evaluation!!! Second place passed the practical tests which are preferred by 29.63% of the respondents. This shows the importance it attaches to the actual performance of the pupils proven by practical tests in awarding the final semesters or year marks. The alternative samples are chosen by 18.52% of the teachers for summative assessment. An explanation would be that they require a long time in design and realization, are less common during the semester, but are completed and taken into account in the final assessment of students. Oral samples are the least use as methods in the summative assessment, probably being considered as a form more suited to the role of the current assessment (through the error correction function, improvement and adjustment of the learning process).

Item no. 3

Sort the presentation methods below according to the importance you give in the **objective assessment** of a student: oral evidence, written evidence, practical evidence, systematic observation, investigation, project, portfolio, self–evaluation.

In the empirical assessment of objectivity quality, teachers credit written evidence with the highest objectivity (with 28.86% of the options). Oral samples are considered second (with 18.57% of options), likely to be relevant because they can check on the spot the certainty of a correct answer, level of understanding, etc.

Teachers are also based on the systematic observation of student behavior over the training period (by 13.07%) of the options). Although they choose the second place in the summative evaluation, they do not consider this evidence to be very objective (only 10.70% of the options). Practical evidence is easy to administer and evaluate globally (whether or not achieved, performance achieved or not), but it is harder to assess by scales and criteria previously set, so they are less objective if not used properly. Alternative assessment methods are appreciated with low objectivity, probably due to their insufficient knowledge (theoretical) and lack of practical experience. In the primary cycle, efforts are being made to develop self-evaluation capacity in pupils, but their self-evaluation is not taken into account in the teachers' assessments. Probably higher grades, especially high school, self-assessment of students is a benchmark and for the teacher in establishing the grade and / or rating awarded.

Item no. 4

What kind of **written tests** you frequently use (3 options):

Written evidence is the most widely used evaluation method. Of the categories of written tests that can be used in primary education, the most common are the knowledge (with 41.36% of the options). It is still an avatar of the traditional informative education which is still preserved today. In vain, we strive to use modern methods of training that do not focus on knowing but on TO DO, TO BE CAPABLE, etc., if the evaluation remains focused on measuring knowledge. Tests used to diagnose learning difficulties have an optimistic percentage: 26.54%, probably due to the new concepts of integration of children with special educational needs in normal school and of psycho-diagnostic modules included in various forms of teacher education. Skills tests gradually penetrate into the teacher's daily practice (by 15.43%) of the options). However, we mention that most of those who made this choice are working in the first grade, so they used the tests for initial diagnostic skills. School progress tests are not currently used (only 7.41% of the options). It is preferable to report performance to those of the reference group or to the objectives of the program and the criterion of reporting to the previous performance is neglected.

In formulating and managing written evidence, teachers prefer short-answer items (requiring a limited response as space, form and content) and completed (asking the student to produce a reply that complements an incomplete statement or a lacuna statement and gives value of truth) by 22.22% and 19.14% respectively. It's easier to work out and easy to fix. They are preferred in the order of association type (with 15.43% of the options), which are very attractive for pupils, even at a lower age (the possibility to use images), then multiple choice (with 13.58%) of the options).

Both are objective items with closed responses commonly used in inter-school competitions (eg, Kangoroo, Assessment in Education). A fairly small percentage is found for problem-solving items (only 11.73% of options), probably because they are too complex for young school age.

Semi-objective items (46% of the options) are preferable to objective ones (39% of the options) although they are to some extent removed from the maximum objectivity in correction and scoring provided by objective items. These items require the student to "produce" a response, usually short, which will allow the evaluator or examiner to formulate a value judgment on the correctness of the subject's response.

Item no. 5

What is the **main source** of the items used in the written tests (one option)

Teachers use iterations taken from various teaching aids (test collections) in the evaluation samples - 33.33%, from tests elaborated by institutions of M.E.C.T. - 24.07% or even in the student's manual - 22.22%). We observe a limited concern to develop the only evaluation items that are appropriate to the situation (only 16.67% of teachers declare to do so, the rest of 83.33%) take up items from other sources.)

4. CONCLUSIONS

The basis for changing the attitude of the teacher towards the school assessment is the shift from the normative assessment to the formative assessment which constitutes "a new paradigm in the evaluation". The normative assessment focuses on highlighting the individual differences between pupils and on the absolute performance criterion presented in the objectives and the curricular performance standards.

The formative evaluation promotes a new approach in which "the learner's progress is increasingly interested in time, in relation to the previously defined pedagogical objectives." Developing on the ground of pedagogical innovation, formative assessment supports the realization of a differentiated pedagogy that "allows for interactive regulation" in which "the trainer is not only interested in the outcome but also in the process leading to this result."

Evaluation should be seen as a process that promotes learning rather than as an external control done by the teacher on "what he does" and "how the student does." Included in the learning act itself, evaluation requires more attention, both from the teacher and the student, on the processes taking place in learning, on the causes that lead to errors and on the factors favoring knowledge.

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COUNSELING OF PARENTS AND CHILDREN FROM DISABLED MEDIA FOR PREVENTIONTHE FAILURE AND ABANDON OF SCHOOL

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Abstract: *The interest in developing the capacities and skills of children with certain development risks is not limited to children with special needs but also extends to socially and culturally disadvantaged children. In their effort to meet academic requirements, often so high, many students with no developmental retardation or without exceptional psychological needs have the experience of school failures. As a result, their chances of reaching self-esteem and good social integration are jeopardized. Certain child deficiencies are not due to their innate cognitive characteristics, but to other causes such as: lack of experience in a specific learning context, lack of prior knowledge, lack of adequate language, lack of transferable strategies for tasks, lack of constant attendance of institutions providing formal education, lack of direct involvement of parents in the school life of children. Through proper task mediation, by encouraging the transfer from similar learning activities, by learning strategies and notions, through activities to develop and optimize emotional and social skills, the child can acquire the ability to overcome his usual level of performance and to go to the higher one. The main purpose of this paper is to provide educational support and specific integration for identified benefit groups.*

Keywords: *school failure, learning, educational support, education system, formal education.*

1. INTRODUCTION

Everyday reality and statistics outline the picture of a troubled society. The physical and mental health of children and young people is in danger. The family, school, entourage, and broadcast - the four backgrounds of the child's current life - are declining in pedagogical values.

The environment in which the child is born, lives the first years of life, develops and is formed for life is provided by the family. It is a first tool to regulate interactions between the child and the social environment. The family has the central role in providing the necessary conditions for the transition through the stages of childhood development, conditions that underlie the structuring of the personality of the individual. This is why the family relationship, the affective climate and its socio-cultural model are important in social integration and in building social behaviors.

A family-school relationship has a very important role in the success of the instructive-educational process, which is why the teachers have to pay special attention to the communication with the children

2. OBJECTIVES, HYPOTHESES OF RESEARCH

General Objective:

Preventing and correcting early school leaving among 6- to 8-year-olds in disadvantaged communities with a high proportion of rromi.

Research objectives:

• Measuring the degree of involvement of parents in formal and non-formal education of children, by initial and final questioning of parents and teachers.

• Developing parents' abilities to mediate learning as an environmental adaptation factor through the parental education program.

• Defining the usefulness of customized counseling programs for parents and children from disadvantaged backgrounds.

Research hypothesis

By implementing a parental and personalized intervention program in counseling hours with parents and children from disadvantaged backgrounds, the phenomenon of school drop-out is reduced and the continuity between pre-school and school levels is reduced.

Sample of research:

The research was carried out on 60 children aged 6 to 8 years enrolled in mainstream education.

3. TOOLS USED IN RESEARCH

The questionnaire addressed to teachers was also designed to measure family involvement in child education as well as the relationship between family and school. While retaining the same form as the parental questionnaire, the first part gathers information about the personal data of the teacher, namely the gender, the level of his / her studies, and the second part, through 13 items, to highlight the degree of parental involvement in children's education, and the relationship they have with the school. Response variants are diverse as the parent questionnaire.

Parent education program

Parents' education contributes to their social and spiritual emancipation. As a subsystem of lifelong learning, it responds to specific, concrete needs and offers alternative ways and conditions of self-education.

Family and parental education addresses actions aimed at exercising the educational function and developing effective practices of communication and family interaction.

In order to fulfill the fundamental function of the family, the child's security, and its socializing role, the defining purpose of parental education is to form their educated conscience, the awareness of the necessity of a continuous effort to the needs of the child, including education.

From the perspective of systemic analysis, parent education appears as a dimension of permanent education and, of course, adult education.

Data analysis

Referring to the purpose of this research, that of counseling parents and children from disadvantaged backgrounds to reduce absenteeism and preventing school dropout, we have recorded the values of the attendance of the school units in which children are enrolled.

For the same dimension, namely the importance of formal education in parents' view, we also analyzed the results obtained by those in the control group. Thus, if initially 26% of the parents were at the weak level, 18% were in the final stage. At the average level of the scale, 68% of the subjects were in pretest, so 76% would be registered in the posttest phase. At the last level of the measurement scale, respectively the high level, both in the initial phase and in the final stage were 6% of the subjects. As we can see, comparing the results obtained in the observational stage with the ones in the evaluation stage, small differences are recorded within the levels of the measuring scale. The obtained results entitle us to affirm that parental absence from parental education leads to the idea that formal education of children is of little importance in their development, in their formation as active members of society. The concerns of these parents remain paperbacks in the area of satisfaction of subsistence needs, the fingerprint transmitted to younger generations.

In relation to the previous dimension, the values recorded for parents' involvement in school life for the experimental group are the following: 72% of the subjects are at a weak level in the initial stage and only 34% in the evaluation stage; 28% of subjects are at the pretest average level and 40% in the posttest phase. For the high level, if no results were initially recorded, an important percentage of 26% of the parent subjects is at the evaluation stage. The values mentioned before lead us to affirm that the degree of understanding that the responsibility of the

The results obtained by subjects in the control group show the extent of parents' involvement in school life the following values: initially 84% were at the low level, 16% at the average level. In the final stage, 80% of the subjects were at the low level, 18% at medium level and 2% at high level. The extent to which parents are aware of the importance of adult involvement in the schooling of children remains low and has an impact on the entire educational community. Lack of involvement in school life of children influences their results in a negative sense, because education is not a process that is exclusively responsible for school, but a process whose success depends on the collaboration between the two sides.

The last dimension measured by parents' questionnaires is the need for school support. If before the participation in counseling activities, the majority of the parents in the experimental group, namely 96% were at the average level and only 4% at a weak level, at the evaluation stage parents feel the need to provide support from the the school, their answers revealing this fact by the percentage of 58% at the average level and 42% at the high level.

For parents in the control group, both at pretest and posttest, the highest percentage is at the median level of 92%. For the poor initial level it is 8% and the final 6%, and for the high level only in the evaluation phase there is a small percentage of only 2%.

By comparing the two groups involved in our study, experimental and control, we see that the awareness process of the importance of family education is spontaneous, through impulses and external demands, especially from the school.

In our study we also recorded qualitative observations by applying the set of questionnaires to teachers in both stages of the experiment.

The recorded responses strengthen the conclusions obtained and described on the basis of the previous graphs, namely that the intervention programs carried out in collaboration with the parents aim at optimizing the cognitive, social and emotional development of the children by applying in the family environment the parental skills acquired during the activities, as well as facilitating healthy and functional relationships between parents and children by replacing aggressive behaviors with appropriate relationship behaviors.

In this paper I would like to highlight the importance of counseling children, in forming their personality and in their preparation for life.

Increasing the number of school failures and dropouts, delinquent or unhealthy behaviors, emotional disturbances among students, are indicators of the fact that the school has to do much more in this direction. In order to meet these real needs, the Ministry of Education and Research proposes through the new National Curriculum the introduction of Optional, Counseling and Orientation, for all three levels of education: Primary, Secondary and Secondary. The new discipline meets the basic needs of any child and teenager: self-knowledge, communication capabilities, creativity, decision-making and problem solving.

4. CONCLUSIONS

Through education, parents can acquire the necessary knowledge and skills to meet these goals that are driving the growth and education of children. Research shows that in programs involving parents' participation, pupils have higher school performance than in the same programs but where parents are not involved. The degree of involvement of parents in the schooling of their children also influences their results in a positive way, because education is not a process that is exclusively school responsibility, neither parents responsibility. Thus, in this process whose success depends on the collaboration between the two parties concerned, the more parents collaborate with the school, the more the children's grades are, and their degree of adaptability to the requirements of the educational environment is higher. In this context, one of the hypotheses formulated for this research is the following: *if parents of children from disadvantaged backgrounds participate in the parental education program, then their degree of involvement in the education of children will increase.*

Based on this hypothesis and following the statistical processing of the data obtained, we draw the following conclusions:

● **Awareness of family education** is spontaneous, through impulses and demands from the outside, especially from the school, which largely determines the priorities, content and means of education in the family. Although the school's social prestige has declined, the educational prestige of the family is mainly related to the school success of children.

There is a conditioning of the quality and aspirations in the family education from the cultural "dowry" of the family including the schooling of the parents, the experience accumulated in the families from which they come, the participation of the parents in the cultural life of the community, including the school life of the children.

It is important for children to cooperate with parents, to balance their authority and to involve children in decisions that concern them. Children need to participate actively, concretely in the life and family tasks, without neglecting the "burden" of schooling.

● **Parenting practices and styles** are not unitary and are not uniformly received. There is a predisposition of parents to be protectors, caring for the education and future of children, and they even express appreciation and expectations in this respect. There are, however, no specific requirements, control and sanctions for the roles of children in the family, which focus on the outcomes of life and work outside the family for the most part.

● **The intervention program** developed in collaboration with parents aimed at optimizing the cognitive, social and emotional development of children by applying in the family environment the developed parental abilities during the activities and facilitating healthy and functional relationships between parents and children and between parents and teachers. The program also proposed a model for the change of psycho-educational practices in the school environment comprising a disadvantaged population from the point of view of the background environment by replacing the aggressive behaviors with adequate relationship behaviors, by learning ways of coping and managing the conflicts.

● **Involvement of parents** has led to the prevention or elimination of inherent difficulties in the life of a school. Together, parents, children and teachers can make school a good place for everyone involved in the educational process, an environment based on trust, communication, respect and flexibility. Creating an adequate learning environment is the task of the family and school equally. The child has diverse learning tasks: some are fulfilled at home, others at school, which ensures a similar degree of importance to both teachers and school as a whole, as well as to parents and the family environment.

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EDUCATIONAL GAME. A BEST PRACTICE FOR IMPROVING ACADEMIC ACHIEVEMENT TO STUDENTS WITH SPECIAL EDUCATIONAL NEEDS

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Abstract: Integration of persons with disabilities is a matter of topical interest. Although the current educational system encourage and promote the educational integration, the process of integration of children with special educational requirements (SEN) in the inclusive schools is still, in contemporary society a real challenge. In the current context, investigating and re-evaluation of the solutions for the recovery of children with disabilities is required. Starting from these ideas, the present article proposes a new forms of support for the child with disabilities through the game. Thus, the first part of the article presents general considerations relating to the game and finally are offered examples of games to develop the skills for writing-reading and numbers to students with special needs.

Keywords: *educational game, special educational requirements, academic achievement*

1. INTRODUCTION

Educational game is a type of game combining instructive, educational elements with fun. (Purcaru, 2008). Moscal (2006), Purcaru (2008) emphasize the fact that educational game differentiate itself among other games through objective, content, educational task, rules, action of the game, elements of the game and teaching materials.

In order to make the educational game effective, Putnic (2006), Purcaru (2008) add the following *conditions for organising the game*:

- clear formulation and clear settle of the aim and title of the game
- specification of the objectives to be pursued
- the explanations of the teacher should be short and simple, conducting the learning during the game
- rules of the game should be few and simple, simple in order to be understood and learned easily
- special attention should be given to preventing conflicts, superiority or inferiority complex
- games will be varied to offer any child the opportunity to win
- organisation of the group should be homogenous as to provide equal chance to each group.

A special attention should be given to the children with learning difficulties, by stating the criteria for successfully doing the game, ensuring the transfer by complicating the game, providing the necessary material conditions, adjusting the content of the game to the students' particularities, using a variety of teaching aids, attractive for the students.

2. INTERVENTION

The purpose of intervention is the development of writing-reading-numbers skills. The method used is the educational game. Intervention can be applied, either by teachers in the classroom, in the extended group, both for the typical students and students with special needs, either by specialists (speech therapist, teacher support) in the resource room, in the framework of the individual therapy.

Examples of activities:

"The Animal Alphabet"

Objectives: 1) identification, 2) sound recognition, 3) association with the capital letter

Materials : cards with pictures and letters on both sides

Description: The package contains double-sided cards, with letters and pictures of animals that begin with the respective letter (A-bee). The teacher puts the cards with animals (only those cards with the letters that will be learned in the context of that activity are chosen, (for example A-M), asks the student to choose an animal, the teacher pronounces the word first and extends the first sound, asks the student to say what sound the words starts with, it is associated with the image (A from the "albină" - bee), the card is turned and the capital letter is shown. The teacher changes the position of the cards on the table and asks the student to choose an animal that starts with "M".

In the course of other activities, apart from the letters A-M, other sounds and letters are introduced, the student is asked to recognise the letters learned previously, the identification and recognition of sounds and letters newly introduced.

"We learn the alphabet"

Objectives: 1) sound identification, 2) recognition of letters, 3) associating the sound with the capital letter, 4) the analysis of the graphic signs that compose the letter

Materials : cards with letters and pictures, notebook, writing instruments

Description: The package contains cards with letters and pictures that start with the letter in question. The teacher puts on the table the cards with images on one side and the cards with letters on the other side. The student chooses an image, the teacher prolongs the initial sound, the student identifies the sound and searches for the appropriate letter. It can be played the other way around, a letter is selected or the teacher tells the student what letter to choose, the image is found whose name begins with the letter in question, the graphic signs that compose the letter are identified. The letter is written on the notebook.

"The sculptor"

*Objectives:*1) letter recognition, 2) identification of graphic signs which compose the letter

Materials: modelling clay, match sticks, wire, cards with letters

Description: The teacher puts on the table the cards with letters asking the student to show the letter, the graphic signs are identified, the student forms the letter from wire, then from modelling clay and then from sticks.

"At the seaside"

Objectives: 1) letter recognition, 2) identification of graphic signs which compose the letter

Materials : plate with sand (or flour), cards with letters

Description: The teacher puts on the table the cards with letters asking the student to show a letter, the graphic signs are identified.

The student writes the letter in the sand (flour) or the student writes a letter in the sand (flour) and asks the teacher to guess what letter he has written, the teacher asks for details (what the letter is formed of), the student must say what he drew to write the letter.

"Guess the letter"

Objectives: 1) letter recognition, 2) identification of the graphic signs which compose the letter

Description : The teacher writes with his finger on the back of the student a letter, he must guess what letter he wrote.

"Magnetic syllables"

Objectives: 1) formation of syllables, 2) syllables reading, 3) copying syllables 4) dictation of syllables

Materials: magnetic whiteboard, colored letters, notebook, writing instruments

Description: This game is made each time a letter is taught, in addition to the letter taught which will be of one colour, other letters are added of other colours and syllables will be formed. The combination of the two letters is done in front of the child. The teacher puts on the magnetic board the letter M, in front of the letter M, he puts in turn the letters A, I, O, U, the syllable is read, it is copied in the notebook. In order for the exercise not to be abstract, words beginning with the syllables in question are found , the syllables will be taken from the visual field of the learner, and the practiced syllables are dictated.

"The race"

Objectives: 1) formation and reading of syllables, 2) forming and reading words, 4) copying syllables and words

Materials : cards with letters

Description: The teacher puts on the table only letters (he begins with two letters, and along the way, others are added). The teacher has in front of her/him the letter M, the student has in front of her/him the letter A, the two letters are cars that collide, M comes towards A and when they collide they form the syllable MA, the student reads the syllable, copies the syllable formed with the help of the cards on the notebook. The two syllables come together to form the word MAMA (MOTHER), the student reads the word and copies it in the notebook. Other letters already studied are also added and words are formed.

"Objects and their use"

Objective : 1) association

Material: cards with objects and cards that illustrate their usefulness

Description: The teacher puts on the table cards with objects on one side and cards showing their usefulness on the other side, asks the student to select an object, the teacher pronounces the name of the object, the student finds the card that shows what we do with that object, a pair is made (e.g. chalk-board, watering-can - flower, pencil-pencil sharpener, etc.)

"Families of animals"

Objectives: 1) forming an set, 2) identifying the elements of a set, 3) sorting

Material: cards with families of animals (e.g. hen, rooster, chicken, lion, lioness, lion cubs)

Description: The teacher puts on the table the cards with the cubs of the wild and domesticated animals and the cards with the parents of the wild animals and domesticated animals, asks the student to choose a cub, the teacher pronounces the name of the cub.

The student finds its parents, forming a family of animals (a set), identifies the elements of the set (names with some help the family members), after forming the families of animals, the teacher asks her/him to group them in families of wild animals and families of domestic animals.

"Fruit salad"

Material: cards with the image of some fruit, cards with the image of some fruit cut into half

Objective: 1) association, 2) forming sets, 3), sorting, 4) identifying the notions of half/whole, 5) estimation of quantity

Description: The teacher places on the board the shuffled cards, asks the student to form two sets (of whole fruit, of cut fruit), asks the student to make pairs, then the teacher takes the card of a cut fruit, gives the student the card of a whole fruit, asks the student who receives more, after the formation of the pairs, the student must sort the fruit according to their colour.

"The pyramid"

Objective: 1) ordering of elements by size

Materials: game, pyramid tower

Description: The student must build the pyramid, he will order the pieces from the big ones (base of the pyramid) to the small ones (top of the pyramid), the order is discussed. This game anticipates the sequence of the numbers.

"Rulers"

Objective: 1) ordering of elements according to length

Materials: rulers of varying lengths

Description: The teacher asks the student to order the rulers from long to short or vice versa, which would clearly show length. This game anticipates the ascending and descending order of numbers.

"Cars and neighbours"

Objectives: 1) formation of sets, 2) ordering by size 3) identifying the position of some elements in relation to others

Materials different sizes: cars of different sizes and colours

Description: The teacher places the coloured cars on the table, gathers together the cars (a set), talks about this, asks the student to order the elements of the set by size, from big to small or vice versa, the teacher asks the student what is in front of (before) the yellow car, what is after the yellow car. This is exercised with as many objects as possible. This game anticipates the neighbouring numbers.

"Who has more"

Objectives: 1) the appreciation of amount, 2) the introduction of terms more/less, 3) introducing symbols

Materials: small dimension objects, cards with symbols +,-

Description: The teacher puts on the table small toys, asks the student to choose what toys he likes and asks her/him to form a set. It's the teacher's turn to choose, depending on how many toys the teacher chose, he chooses visibly less, a visibly smaller pile, he asks the student who has more, next to the pile with visibly more toys, the addition sign is placed, and next to the pile with fewer toys, the subtraction sign is placed, it is said aloud, insisting on using specific terms (bigger, smaller, more, less)

"Let's build with sticks"

Objectives: 1) the estimation of amount, 2) the introduction of the terms more/less, 3) introducing symbols

Materials: matchsticks, cards with the symbols +,-

Description: The teacher forms two piles of sticks, visibly different in size, and asks the student to put next to each pile the appropriate symbol, it is said aloud, a house of sticks is built.

"Feed the puppy"

Objectives: 1) the formation of piles with a number of objects corresponding to the number of sounds heard, 2) the estimation of quantity

Materials: toy puppy, cardboard bones

Description: The teacher asks the student to feed the puppy with as many bones as the number of knocks in the table he hears (the professor slowly knocks on the table), the first pile is formed, then the teacher asks the student to give the puppy as many bones as the number of handclaps he hears and to form the the second pile of bones, the student says where there are more bones.

"Do as I do"

Objectives: 1) the formation of similar piles to those made by the teacher, 2) forming piles on an image, 3) introduction of the term and symbol ”=”

Materials: chips, cards with sets, cards with the symbol „=„

Description: The teacher forms a pile of tokens, the student must form a similar pile, it is said aloud, it is associated with the symbol =, then the student receives images of objects and must put on the table as many tokens as the number of objects in the picture, the symbol ”=” is placed.

"Sets and numbers"

Objectives: 1) the association of set - number, 2) associating the quantity by numbers

Materials: “Numbers”, playing cards (contains cards with sets, cards with numbers)

Description: Until now, sets have been formed and the quantity of items in a set has been estimated roughly, without being associated with figures. The teacher puts on the table cards with sets (sets of tractors, sets of frogs etc) and cards with numbers (1 to 5), asks the student to choose a set, define the set (the set of butterflies), asks how many butterflies there are, counts together with the student the butterflies, the last word said indicates the quantity (if he stopped at three, that is how many butterflies there are) searches number three, puts it next to the set with butterflies, and repeats the procedure with the other sets. On the table there are now the set of objects and the corresponding number, this is repeated with each number.

“Palettes with numbers”

Objectives: 1) the association set-number, 2) the association quantity-number

Materials: “The game of numbers” (contains cards with sets, cardboard pallets with numbers)

Description: The student receives the palettes with numbers from 1 to 5, the teacher places on the table a card with sets (the set of spots), the student must count the spots from the card and to raise the respective palette. It is practised with as many sets as possible.

“Puzzle”

Objectives: 1) the association set-number, 2) the association quantity-number

Materials: the puzzle “The alphabet, the numbers and the addition”

Description: Each number (1 to 10) is a puzzle made of three pieces, in the middle you have the image of the number represented through fingers, on the left there is a set of objects representing the respective number, the student must unite the pieces in order to associate the set with the number, the pieces for a number have a certain colour. After uniting the pieces, the elements of each set are counted, they are counted on fingers, the number is repeated.

CONCLUSIONS

The use of the educational game in the learning and recovery process of students with or without deficiencies is supported by studies from the literature (Sylva et all. (1976), DuPaul, Eckert (1998), Baker et all. (2002), Basil, Reyes (2003), Gee (2005), Ignat, Duta (2010). The results of these studies showed positive effects in the academic, non-academic, cognitive and non-cognitive plan, as follows:

- the game improves the ability to read
- stimulates memory
- make improvements to the cognitive level, IQ coefficient increases,
- stimulate creativity
- keep the attention focused,
- develops the ability of understanding and problem solving,
- allows solving emotional, reduce anxiety, increase self esteem
- improve social skills,
- decreases hyperactivity,
- improves motivation,
- develops empathy, stimulates the communication expression of emotion,
- reduces the problematic behaviors and aggression.

Thus the present work becomes a support theoretical and practical for specialists in the field of education, providing examples of activities which can be used both in the activity of the teachers in normal education, as well as in the work of teachers and specialists in schools inclusive, all contributing to the educational integration of pupils with deficiencies and later to the social integration

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CONSIDERATIONS ABOUT THE IMPACT OF THE MEANS FROM JUDO'S SPECIFIC KATAS IN MULTILATERAL PREPAREDNESS OF THE FUTURE MILITARY COMBATANTS

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Abstract: *This paper intends to outline the impact of using some katas from judo during the multilateral preparedness of the military students in general, and particularly for those from "Henri Coandă" Air Force Academy. The means of the selected katas were adapted to military requirements and the graduate profile in accordance with the following: an excellent health index – as a fundamental base of the whole process; harmoniously physical development; specific physical development; technical and tactical development and psychological development. According to tai-gin-shin formula, all these elements will lead the young military students to the following: better mental focus; higher level of general and specific resilience; calm and self-confidence; faster decision; increased reliance in their actions; greater adaptability in various conditions; combat spirit, and nevertheless the team spirit.*

Key words*: kata, multilateral preparedness; judo; tai-gi-shin*

1. INTRODUCTION

Looking back over the time, more or less than one hundred years, we can discover that martial arts in generally and judo especially have started their fulminant development, with a lack of refinement. The techniques had not a large scale of versatile and diverse combinations, they were scarce, simplest, but they respect and deploy seriously the basic principles of Judo: the use of opponent energy, harmonious blending, attention speculation, and flexibility.

The fight between two budoka (fighters) in those periods of time was not biased by their weight as it started at the end of 60's, when most of the martial arts have started to be considered sports. A shiai (fight) was not regulated rigorously as in our times; the fight should have even two hours in length. The opponents were determined to show the superiority of their martial arts skills by being violent, extremely aggressive. The toughness of these contests was also tributary to the rivalries among various schools of martial arts.

In 1882, Jigoro Kano, one of the best masters in various styles of Jujitsu, had started to select the less dangerous but efficient techniques, easy to be performed in order to create what were called modern Jujitsu. Other representatives of Kodokan Japan called it Judo Kodokan, saying that this creation is mostly sport rather than martial art.

Jigoro Kano reiterated that his study on Jujitsu was motivated by the most interesting blending of education for body and spirit and found a strong drive to share everywhere and to anybody this art.

He was interested in creation of a national curriculum in order to provide to all Japanese people a harmonious way of development of their body and spirit, even the initial Jujitsu was conceived only for combat. [1]

Finally, the name of the new creation was adopted as Judo, the modern child of martial arts.

In Kano's perception, the new method represented another way to cultivate the physical and mental strength in order to reach three objectives: an education model, self defence instruments and military and moral education. [2]

During 1882 and 1902 the Judo techniques were included by the founder in many different Katas.

Kata (form, model) is not an invention of Kano. It represents an old system used in Japanese culture. Many Buddhist papers mentioned about Hangaku, as origin or born enlighten. Each living being has the potential for enlighten and salvation by practicing and continuously search.

The general definition for Kata was Shiki Soku Zeku. Was first time mentioned by Buddha and had the meaning of emptiness or void, but not with the understanding of nothing. But what represents the emptiness? Is it shapeless, without consistency? For Western culture, the emptiness represents a space without mater. For Asian culture, the emptiness is the form – Kosoku ze Shiki. All things which create the Universe have a unique source and form, they have the force. Ku and Shiki are energy and force in the same time. We can ask ourselves if we can perceive the form. A positive answer is coming from Zen masters. They affirm that using our mind according with Shimi Keigei principle we have no limits in this respect. Nobody can stop us to dream that we are on another planet, billion miles away from Earth. [2]

After professor Kano's death, Kata has been used in practice but not as key element of Judo. When randori (free practice) has been developed, Kata started to be eliminated form judoka's training. In 1956, grand masters of Judo former Kano's students (Amano, Oda, Izuka, Mifune, Samura, Okan, Kuihara, Kanamitsu, Kurata and Nakano) have had a meeting to revise the entire curriculum of Kata. First Kata Championship had place in 1960, under supervision of Kano's nephew, Risei Kano, when World Judo Foundation established the Kata variants. Many countries have decided to implement the new model of training in their national federations.

A long period of time, kata almost disappeared as practice and preparedness because many Judo teachers considered it as an obsolete method, lacking on practicality. According with their view, the competition (shiai) is the only evaluation way.

In the same time, Kodokan – Japan has become aware about the dangerous way of the brutal competition of Judo, which may led through Judo disappearance. Some officials have proposed to educate Kata instructors with the main role to show the true face of Judo. This strategy has been successfully and now we can find Judoka all over the world, even a World Judo Kata Championship.

In 1960, Kodokan Japan established in a large board the standard curriculum for kata:

1. Nage-no-Kata (Forms of throwing) – with five forms of throwing, three basic techniques each;
2. Katame-no-Kata (Forms of grappling and holding) – three sets of five basic techniques;
3. Kime-no-Kata (Forms of decisiveness) – twenty basic techniques illustrating combat situation, performed from kneeling and standing positions.
4. Kodokan goshinjutsu (Kodokan skills of self-defense) - comprising twenty-one techniques of defense against attack from an unarmed assailant and one armed with a knife, stick and pistol.

5. Ju-no-kata (Forms of gentleness & flexibility) - Fifteen techniques, arranged in three sets of five, demonstrating the principle of Judo and its correct use in offence and defense, according with Chinese Yin-Yang principle.

6. Koshiki-no-kata (Traditional form) - Derived from Kitō-ryū Jujutsu, comprises two ways – Takenaka-ha and Yoshimura-ha. This kata was originally intended to be performed wearing armour, as ancient samurai families used to do beginning with 8th century. Kano chose to preserve it as it embodied the principles of judo.

7. Itsu-no-kata (The five forms) – it was created by Jigoro Kano itself. In 1887 he was inspired from Tenjin Shinyio-ryu school, where can be found five combat elements: Oshikaeshi (continuously pushing), Eige (draw the drop), Tomo-wakare (the separation), Rain (the tides energy), Settsuka-no-wakare (the instant separation). The model remains unfinished because of the sudden death of Jigoro Kano. The creator of Judo intended to introduce the model alongside with aikido and Chinese philosophy elements.

8. Seiryoku Zen'yō Kokumin Taiiku (maximum efficiency, minimum effort) – it was developed in 1924 and can be practiced by any judoka. It represents a set of techniques performed at high speed and strength, with partner or not. [2]

Most of the specialists in this domain are considering that the most accessible Kata variants may be Nage-no-kata and Katame-no-kata for judoka at their age of 16, and are ideal for military students at their age of 19-21. Meanwhile, learning too many techniques without the basic knowledge of Judo is counterproductive.

Barbos Ion-Petre has been describing the founder of Judo, Jigoro Kano, which have created and developed Kata, as following:

1. The understanding of attack and defense objectives. Approaching the combat from the defense point of view only is totally wrong because is ignoring the internal forces of tori (the one who is attacking), as tori is fighting alone. The both sides have to reflect the all three elements which lead to harmoniously movement: physical, emotional and spiritual.

2. The development of ambidexterity, knowing the fact that most of the practitioners are performing only on the one side.

3. Developing the optimal and esthetical attitude and standing position for fight.

4. Controlling the own body and uke's (the one who is defending) body, developing the necessary reflex skills for real fight situation. The movement has to be always elegant and harmoniously, and the forces involved must be the same and balanced.

5. Surprising the necessary moments to perform efficient techniques using the principles of Judo. [2]

2. THE FUNDAMENTAL PRINCIPLES OF JUDO

In the opinion of Vlad Grigore Lascu, the fundamental principle of this martial art consists in the better use of energy. When is considered that in Judo is not essential to develop your strength this idea is not about to deny the role of strength in performing the techniques. The strength is necessary and we can develop a little bit the idea in the spirit of the classical mechanics to describe the force.

To provide this force – as ancient Asian martial art masters demonstrated – is not compulsory to use your biceps but the intelligence and profound knowledge on equilibrium, unbalance, non-resilience, flexibility (ju) and leverage.

In Judo it is not the situation of to lose your balance in order to obtain a victory. Through a proper physical and mental training, judoka may perceive the right moment when the opponent body is losing its balance.

The judoka can develop the art to provoke this moment of losing balance, to play around this moment and to maintain the status of unbalancing for the opponent body.

The synthesis of these principles is the following:

1- the flexibility principle (ju) – to lease, non-violent, flexibility;

2- the principle of unbalancing – when we are pushed back we have to grappling, when somebody is grappling us we have to push;

3- the principle of levers. If we reduce to the simplest form, the leverage is a kind of beam, straight or rounded on which two forces intend to rotate it in opposite directions, around of a hinge, as shown in Fig. 1.

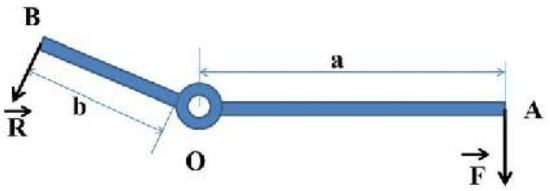


FIG. 1 – Explanatory draw principle of levers

The explanatory of the figure is the following:

F – the effort which lead the system;

R – the resistant force

The smaller letters, a and b, represents the arms of denoted forces, as distances from the fulcrum to points A and B.

The moment of the effort applied in one point is determined by the product between the effort amplitude and the force arm.

$$M = F \cdot a \tag{1}$$

The moment's theory has shown us that the system is balanced when the algebraic sum of the moments is zero.

$$F \cdot a + (-R \cdot b) = 0 \tag{2}$$

In this formula the distances a and b are vertical to the directions of forces.

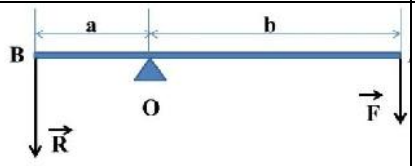
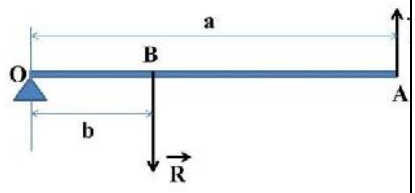
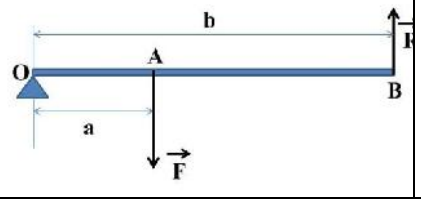
The principle of levers is contributing in the best way to explain the use of energy as an amplifier:

1- the forces: if the length of arm forces shown in Fig. 1 have the ratio b/a = 1/30, with an applied force of 1 Newton it can be override a resilient force of 30 Newton;

2- the movement: if we maintain the ratio of 1/30 between the arms of forces, point A is moving through a quadrant trajectory by 30 cm, despite of point B which is moving only 1 cm.

Levers are classified by the relative positions of the hinge, effort and resistance (or load). It is common to call the input force the effort and the output forces the load or the resistance. This allows the identification of three classes of levers by the relative locations of the fulcrum, the resistance and the effort, as shown in Table 1.

Table 1 – Classes of lever and example of associate Judo techniques

Lever class	Explanatory drawn	Examples in Judo
Class 1		Gyaku Juji
Class 2		Tai Otoshi
Class 3		Morote Gari

4- the principle of actions coordination, perceived by Jigoro Kano as maximum economy of movements and energy, reducing any residual movement to an unique one, starting from hara, seika-no-iten, and connecting all the required muscle in the proper mode.

As well we know, the word Judo is written in Japanese by using two kanji: Ju – meaning flexibility and do – meaning way. If we develop the meaning, the result of understanding of Judo may be: the way through a balanced life using a method of physical and mental education based on empty handed combat discipline. [1]

3. THE ADVANTAGES OF KATA PRACTICING

The adaptation of some means from Kata specific from Judo to the specific of Air Force young students, in accordance with the requirements and graduate profile may lead to the following advantages:

- harmoniously physical development;
- development of specific and general psycho-motric skills, required to professional military;
- development of ambidexterity, to perform the techniques with both parts, right and left;
- development the control over the own and the opponent body, in real and/ or training situations;
- development of spatial and temporal orientation during break falls (ukemi);
- development of surprising capacity of the best moments to deliver the right techniques according to situation;
- development of stress reliance and adaptation capacity for various situations as training, competitions and combat missions;
- development of decision speed, creativity, team spirit as main qualities for a modern professional military from Air Force, with winner mentality.
- consolidation and improvement of motric skills, specific to kata's techniques: Nage-no-Kata and Katame-no-Kata, according to age level of the military students who are practicing Judo;
- learning and developing of an excellent self-defense system;

- developing de team spirit, fair-play, honor, mutual respect and modesty.

4. CONCLUSIONS

By using the specific katas from Judo, adapted to the goals and objectives of the military education and training, we may conclude that the means of Judo may have impact on the multilateral preparedness of the future military officers, only if they are aware to respect the principles.

- Military students must have continuity in the specific judo training process;
- Military students have to respect the specific principles of Judo
- Military students have to know, by studying specific literature, what is happening with their own body from biomechanical, physiological and psychological point of view, when they perform Judo techniques;
- Military students have to know at a very good level which are the objectives to be attend on the short, medium and long term;
- The training sessions have to be held in accordance with proposed objectives.

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INITIATE GREEN HOME CHARGING FOR ELECTRIC VEHICLES

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Abstract: *The research presented in the paper revolves around the electromobility concept, connected with photovoltaic energy and the electricity conversion efficiency. The solar energy feeds the photovoltaic panel, generating electricity that is further transmitted through cables to a battery bank to be stored. From this point the electric current will be redirected to an electric car charging station where finally will reach the electromobile.*

In practice there are not only different types of photovoltaic panels and different structural combinations but also multiple variants of electric charging stations as well as different types of sockets.

A less considered problem, presented in the last chapter of the paper, is the loss of energy due to the wiring components. In the mentioned chapter is highlighted the effects of using improper cable for a certain type of electric car charging station leading to high energy losses or to the uses of oversized cables. The effects determinations is made based on a new developed automated calculation model, on a Microsoft Excel software platform, to detect the power losses and/or achieve a correct sizing of the electric installation to increase the investment efficiency is in line with the expected energy harvesting.

Keywords: *electromobility, solar panel, AC, DC, voltage drop and energy losses*

1. ELECTROMOBILITY

An electric vehicle (EV) is a vehicle powered by an electric motor, instead of an internal combustion engine (ICE) or a hybrid one that runs exclusively with the energy stored in its batteries. EV's have been in continual use, starting with Porsche electric vehicle since 1900s. New advances in battery technology, system integration, aerodynamics, safety and energy management constantly increase the role of electric vehicles.

The EV still presents five major problems: the batteries have to be charged frequently (relatively poor storage capacity) equal if is the long lasting (up to 8 hours, at any main inlet AC 120V or 240V) or swift method (30 minutes); the high costs of the swift chargers (regardless the manufacturer); the missing of the swift charger network; batteries are sensitive to cold temperatures (the range could be reduced by as much as 50% or more); Maintenance, due to high number of components, connectors, batteries mass and the reliability of the electric circuits and the missing of a service network for EV, all are increasing the maintenance costs. Electric vehicles are considered as zero emission vehicles (ZEVs), but how is produced the electricity that is stored in the batteries, how pollute the batteries manufacturing and the batteries recycling.

Generally the EV range and the possible rechargeable cycles are considered knowing that the ordinary range is about 100 km, considering two impact cars the city car BMWi3 (~180km) and SUV EV Kona (~450km).

2. CHARGING THE PROPULSION

Within the doctoral studies attention is given to all 5 aspects with focus on charging management and optimization. The standard SAE J1772 defines six charging levels. Around the world, but only three are currently accepted and frequently used, Table 1 [1].

The Level 1 addresses to the slow charging that operates at 120 VAC, while Level 2 addresses to the slow charger that operates at 208VAC/ 240VAC and to the fast chargers that operates at 200VDC/ 450VDC. The only standards that currently set out specifications for swift charging are the SAE J1772 and CHAdeMO. In parallel, Tesla has developed its own DC fast-charge system, "Supercharger", which can be used only by Tesla [2].

Table 1 – Summary comparison of charging connectivity

	Level 1	Level 2	Fast charge
Voltage	120 V	208V or 240V	200 to 500 V
Current type	AC	AC	DC
Power	1.4 kW	7.2 kW	50 kW
Maximum output	1.9 kW	19.2 kW	150 kW
Charging time	12 h	3 h	20 min
Connector type	J1772	J1772	J1772 Combo CHAdeMO (Supercharger)

EVs are equipped with an on-board Level 1 charger that can be plugged into an ordinary power outlet (CSA 5-15R). For the Level 2 charging stations, the charging time can be limited by the on-board charger specifications and the battery charging state. Tesla offers already on-board 10kW and 20kW chargers.

DC fast charging is governed by the North American SAE J1772 Combo standard (mounted on EV models such as: Opel Ampera, Nissan Leaf and ENV200, Mitsubishi Outlander and iMiev, Peugeot iON, Citröen C-Zero, Renault Kangoo ZE (type 1), Ford Focus, Toyota Prius Plug in and KIA SOUL EV [8]). The Japanese JEVS G105-1993 standard. DC fast-charge stations generally support both standards. All carmakers adopted one of these standards, except Tesla that offers optional a CHAdeMO adapter(developed by a Japanese association: Tokyo Electric Power Company (TEPCO), Nissan, Mitsubishi, Fuji Heavy Industries (Subaru) and Toyota.

Since external device manages the correct charging, it takes into account the battery parameters, transfer functions and communication protocols. The maximum charging power, CHAdeMO standard, is 62 kW (125A at 500VDC), while the J1772 Combo standard sets the maximum power at 100 kW (200A at 500VDC). In practice, very few batteries support 500V, and charging stations are commonly equipped with both standard connectors and limit the rated power to 50kW in contrast with Tesla Supercharger stations rated at 120kW[5]. For comparison it is useful to establish charging times considering 100km range at 80% of the battery capacity, using a feasible output of 40kW.

EVSE (Electric Vehicle Supply Equipment) is an expanding network of public (or private) charging stations but most EV owners want the convenience of a "home" charging option at 3.3 kW or 6.6 kW, but the home wiring and vehicle-charging equipment must be compatible.

3. PHOTOVOLTAIC TEHNOLOGY

Photovoltaics are best known as a method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons by the photovoltaic effect.

Electricity is produced in solar cells which, the most common material for the production of solar cells is silicon. Solar cell manufacturing technologies are:

- Monocrystalline; Polycrystalline; Ribbon- crystalline silicon; thin- film technology

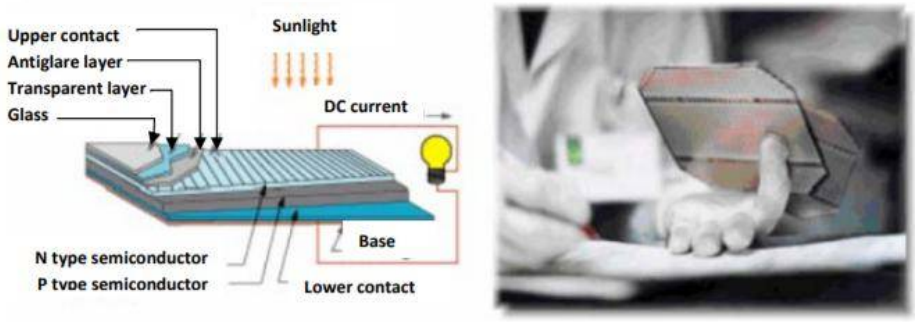


FIG. 1. Typical monocristalline cells

Monocrystalline Si cells, shows conversion efficiency from 13% to 17%, and can generally be said to be in wide commercial use, with an expected lifespan of 25- 30 years.

Multicrystalline Si cells convert solar radiation of 1.000 W/m^2 to 130W of electricity with the cell surface of 1m2, shows conversion efficiency from 10% to 14%, at the same lifespan.

Ribbon silicon has production advantages with an efficiency around 11%[9].

In the thin- film technology the modules are manufactured by piling extremely thin layers of photosensitive materials on a cheap substrate such as glass, stainless steel or plastic. Today's price advantage in the production of a thin- film is balanced with the crystalline silicon due to lower efficiency of the thin- film, which ranges from 5% to 13%. The share of thin- film technology on the market is 15% and constantly increasing, and the lifespan is around 15- 20 years. There are four types of thin- film modules (depending on the active material) that are now in commercial use: Amorphous Si Cells; Cadmium tellurium (CdTe) cells; Cooper Indium Gallium Selenide (Cis, Cigs); Thermosensitives Solar Cells and Other Organ Cells (DSC).

3.1 PHOTOVOLTAIC SYSTEM TYPES

Photovoltaic systems (PV) can be generally divided into two basic groups:

- Photovoltaic systems not connected to the network, stand- alone systems (off- grid)
- Photovoltaic systems connected to public electricity network (on- grid), Fig. 2.

The main components of PV systems are photovoltaic modules, photovoltaic inverter, mounting subframes and measuring cabinet with protective equipment and installation.

Photovoltaic modules convert solar energy into DC current, while photovoltaic inverter adjusts the produced energy in a form which can be submitted to the public grid. The AC voltage is supplied to the electricity network through the protection and measuring equipment.

Photovoltaic inverter is usually located indoors, although there are inverters for outdoor installation.

Inverters produce high- quality AC current of corresponding voltage and are suitable for a network- connected photovoltaic system to deliver the electricity to the electrical network.

Electrical connection is usually located in the electrical control box, which is located in a separate room, but can also be placed in the measurement and terminal box.

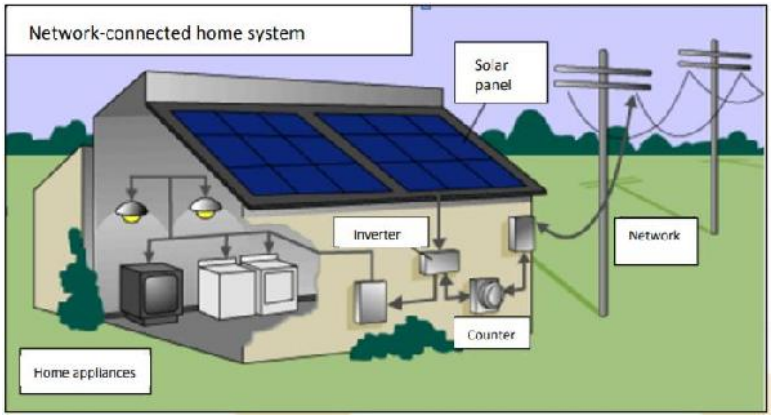


FIG. 2. Network-connected photovoltaic system

3.2 SOLAR POWER PLANTS (FARMS)

These systems are generating large amounts of electricity by a photovoltaic installation on a localized area being connected to an electric network,. The power of such photovoltaic power ranges from several hundred kilowatts to hundred megawatts. Some of these installations can be located on large industrial facilities and terminals, but more often on large barren land surfaces, exploiting existing facilities to produce electricity at the location.

FIG 3. Solar farm

4. AC AND DC ELECTRICAL WIRE VOLTAGE DROP AND ENERGY LOSSES

The developed studies identified two issues that affect the electric vehicles charging:

- Loss of energy recorded in the cable due to overheating
- Loss of energy due to DC-AC and AC-DC transformation

Voltage drop describes how the energy supplied by a voltage source is reduced as electric current moves through the passive. The voltage drop across the internal resistance of the source, conductors, contacts and connectors is undesirable because some of the energy supplied is lost (dissipated). The voltage drop across the electrical load and across other active circuit elements is essential for supply of energy and so is not undesirable. National and local electrical codes may set guidelines for the maximum voltage drop allowed in electrical wiring to ensure efficiency of distribution and proper operation of electrical equipment.

In electronic design and power transmission, various techniques are employed to compensate the effect of voltage drop on long circuits or where voltage levels must be accurately maintained. The simplest way to reduce voltage drop is to increase the diameter of the conductors. In power distribution systems, a given amount of power can be transmitted with less voltage drop if a higher voltage is used. More sophisticated techniques use active elements to compensate for excessive voltage drop.

4.1 Computing voltage drop and energy losses in a wire

Losses in solar PV wires must be limited, DC losses in strings of solar panels, and AC losses at the output of inverters. A way to limit these losses is to minimize the voltage drop in cables. A drop voltage less than 1% is suitable and in any case it must not exceed 3%.

Voltage drop is given by following formula:

$$\Delta V = b\left(\rho_1 \frac{L}{S} cos\varphi + \lambda L sin\varphi\right) \cdot I_B \quad (1)$$

This is phase-phase voltage for 3-phase system, phase-neutral voltage for single-phase system. (Example: for European countries a 3-phase circuit will usually have a voltage of 400 V, and single-phase 230V. In North America, a typical three-phase system voltage is 208 volts and single phase voltage is 120 volts).

Note: DC voltage drop, the system voltage U = Umpp of 1 panel x number of panels.

ΔU = voltage drop in Volt (V)

b = lenght cable factor, b=2 for single phase wiring, b=1 for three-phased wiring

L = simple lenght of the cable (distance between the source and the appliance), in meters

S = cross section of the cable in mm^2

cosφ = power factor

cosφ = 1 for pure resistive load, cosφ < 1 for inductive charge, (usually 0.8)

λ = reactance per lenght unit (default value 0.00008 ohm/m)

sinφ = sin(acos(cosφ))

I_b = current in Ampere (A)

Note: For DC circuit, cosφ=1, so sin φ=0

ρ_1 = resistivity in ohm.mm^2/m of the material conductor for a given temperature. At 20 celcius degree (°C) the resistivity value is 0.017 for copper and 0.0265 for aluminium

Note: resistivity increases with temperature. Resistivity of copper reaches around 0.023 ohm.mm^2/m at 100 °C and resistivity of copper reaches around 0.037 ohm.mm^2/m at 100°C. Usually for voltage drop calculation according to electrical standards it is the resistivity at 100°C that is used (for example NF C15-100).

$$\rho_1 = \rho_0 \cdot (1 + \alpha(T_1 - T_0)) \quad (2)$$

Where:

ρ_0 = resistivity at 20°C

T_0 and α = Temperature coefficient per degree C

T_1 = temperature of the cable (default value = 100°C)

Note: the experiments shows that a wire with a correct sizing should not have an external temperature over 50°C, but it can correspond to an internal temperature of around 100°C

Voltage drop in percent:

$$\Delta U(\%) = 100 \cdot \Delta U / U_0 \quad (3)$$

Where:

ΔU = voltage drop in V

U_0 = voltage between phase and neutral (example : 230 V in 3-phase 400 V system)

Energy losses in a cable is mainly due to resistive heating of the cable. It is given by the following formula:

$$E = a \cdot R \cdot I_b^2 \quad (4)$$

Where:

E = energy losses in wires, Watt (W)

a = number of line coefficient, a=1 for single line, a=3 for 3-phase circuit

R = resistance of one active line

I_b = current in Ampere (A)

R is given by formula:

$$R = b \cdot \rho_1 \cdot \frac{L}{S} \quad (5)$$

Where:

b = length cable factor, b=2 for single phase wiring, b=1 for three-phased wiring

ρ_1 = resistivity of the material conductor, 0.017 for copper and 0.0265 for aluminium (temperature of the wire of 20°C) in ohm.mm^2/m

L = simple length of the cable (distance between the source and the appliance), in meters

S = cross section of the cable in mm^2

*Note:*for direct current the energy losses in percent is equal to the voltage drop in percent.

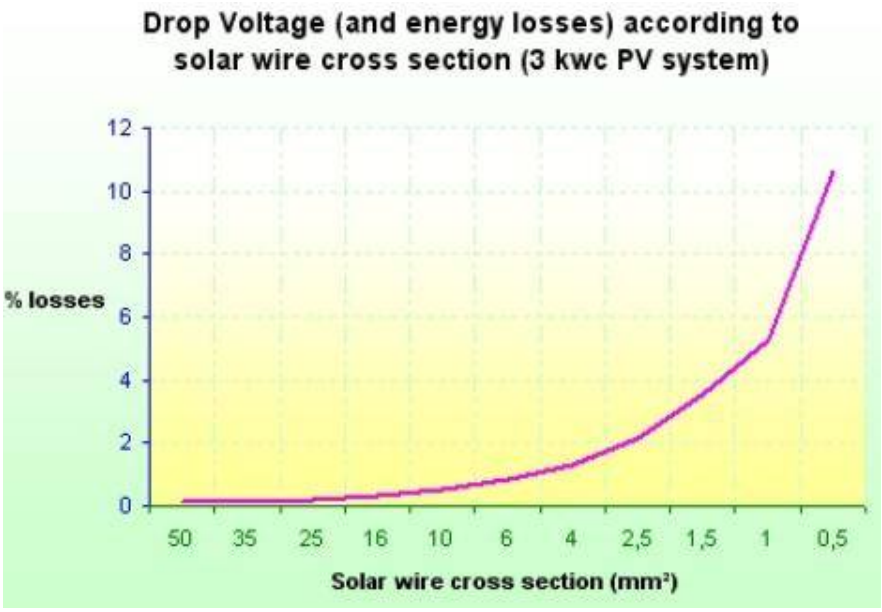


FIG. 4. Voltage drop losses according to wire cross section for a PV system of 3 kWp with 50 m of solar DC string cable.

4.2. AC voltage drop and energy losses calculator

In order to determine AC drop voltage and AC energy losses, a calculation system has been implemented using the Microsoft Excel software. As can be seen in the following figures, only the red color parameters must be pasted/selected. The calculation steps are:

AC POWER		
Type	Single-phase	1
Voltage (U) of the system	Level 1	120
Power factor (PF)	Cosφ	0.9
AC Current	Amper	12
AC Power	Watt	1296

FIG. 5. Determining AC Power

1. Choosing the single-phase or three-phase current type, Fig.5, for one-phase corresponds to a value of 1, for the three-phase corresponds to a value of 1,732, Fig.6.

AC POWER		
Type	Three-phase	1.732
Voltage (U) of the system	Single-phase	120
Power factor (PF)	Three-phase	0.9
	Cosφ	

FIG. 6. Choosing the type of current (single-phase or three-phase)

2. The second step consists in choosing the type of desired charging station (EV Charger Level 1 or EV Charger Level 2). In Fig. 7 automatically switching between EV Charger Level 1 type on EV Charger Level 2 type is represented, switch the amperage (correspondent for Level 1 being 12A or Level 2 being 30A)

AC POWER		
Type	Single-phase	1
Voltage (U) of the system	Level 2	120
Power factor (PF)	Level 1	0.9
AC Current	Level 2	30
	Amper	

FIG. 7. Selecting type of EV Charger

3. The calculation program will directly display the AC Power output in watt, as can be seen in Fig. 5.

4. The next step is to determine AC drop voltage (both in volts and in %), by selecting the cable material (Cu, value = 0.017 or Al, value = 0.0265), Fig. 8.

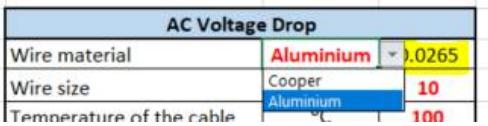


FIG. 8. Cable material selection

5. After selecting the cable material the cable diameter is selected Fig. 9.

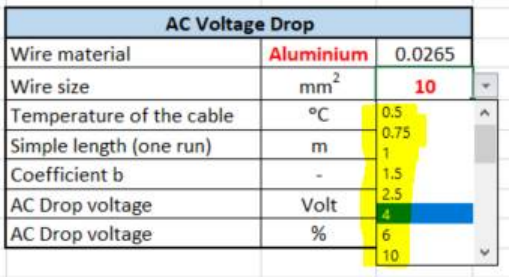


FIG. 9. Cable size selection

6. The made selections, are folod by the input of the cable temperature and the cable total length, resulting the automatic drop voltage calculation (V and %), Fig. 10.

AC Voltage Drop		
Wire material	Cooper	0.017
Wire size	mm^2	10
Temperature of the cable	°C	100
Simple length (one run)	m	50
Coefficient b	-	2
AC Drop voltage	Volt	2.47
AC Drop voltage	%	2.47

FIG. 10. Parameters selection and AC drop voltage presented

7. Performing all the previouse steps, automatically is generated a third table with AC Energy losses (W and %), Fig. 11**.**

AC Energy losses		
Coeffiecient a	-	1
AC Energy losses	W	32.3136
AC Energy losses	%	2.49

FIG 11. AC energy losses in watt and percent

By using this calculation method, the cable diameter that leads to minimizing the power losses can be determined.

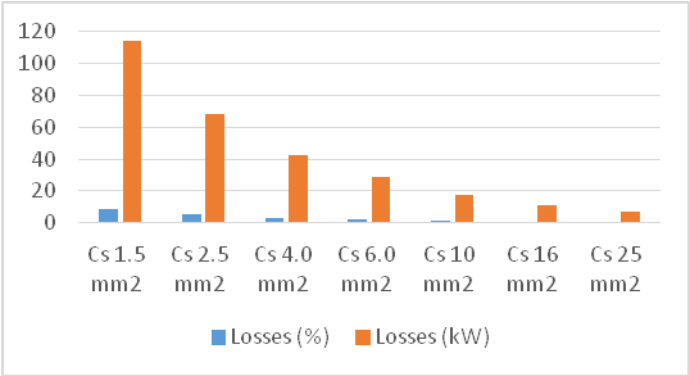
Calculation example: single-phase, with EV level 1 charging station, the cable material copper, maximum temperature 120°C, cable length of 25 m.

In Graph 1 is demonstrated the connection between cable diameter and the loss of electricity.

Tabular calculations rendered the following values:

- Cable diameter of 1.5 mm^2, AC power energy loss of 8.81% (114.24 watts)
- Cable diameter of 2.5 mm^2, AC power energy loss of 5.29% (68,544 watts)

- Cable diameter of 4.0 mm^2, AC power energy loss of 3.31% (42.84 watts)
- Cable diameter of 6.0 mm^2, AC power energy loss of 2.20% (28.56 watts)
- Cable diameter of 10 mm^2, AC power energy loss of 1.32% (17,136 watts)
- Cable diameter of 16 mm^2, AC power energy loss of 0.83% (10.71 watts)
- Cable diameter of 25 mm^2, AC power energy loss of 0.53% (6.8544 watts)



Graph 1. Energy losses according to solar wire cross section (for a 1.3 kW solar installation)

4.3 DC voltage drop and energy losses calculator

To determine DC drop voltage and DC energy losses, a calculation system has been implemented using the Microsoft Excel software. As can be seen in the following figures, only the red color parameters must be pasted / selected. The calculation steps are:

DC POWER		
DC Voltage (U)	SuperCharger (V)	500
DC Current (I_b)	Amper	125
DC Power (P)	Watt	62500

FIG. 12. Determining DC Power

1. The first step is choosing the SuperCharge EV station ampere (as can be seen in Fig. 12). This station type works at a voltage of 500V.

DC POWER		
DC Voltage (U)	SuperCharger (V)	500
DC Current (I_b)	Amper	125
DC Power (P)	Watt	125 / 200

FIG. 13. Amper selection for the Supercharger EV Station

2. By selecting the type of amperage, an automatic calculation of DC Power expressed in watts will be made, as can be seen in Fig. 13.
3. The next step is to determine DC drop voltage (both in volts and in %), by selecting the cable material (Cu, value = 0.017 or Al, value = 0.0265), Fig. 14.

DC Voltage Drop		
Wire material	Cooper / Aluminium	0.017
Wire size		0.5
Temperature of the cable	°C	100

FIG. 14. Cable material selection

4. After selecting the cable material, choose the diameter of the cable through which the desired current passes as shown in Fig. 15.

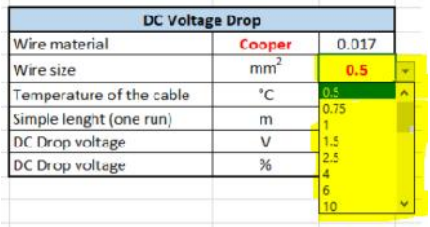


FIG. 15. Cable diameter selection

5. The made selections, are folod by the input of the cable temperature and the cable total length, resulting the automatic drop voltage calculation (V and %), Fig. 16.

DC Voltage Drop		
Wire material	Cooper	0.017
Wire size	mm^2	0.5
Temperature of the cable	°C	100
Simple lenght (one run)	m	50
DC Drop voltage	V	561
DC Drop voltage	%	112.2

FIG 16. Parameters selection and DC drop voltage presented

1. Performing all the previouse steps, automatically is generated a third table with DC Energy losses (W and %), Fig. 17**.**

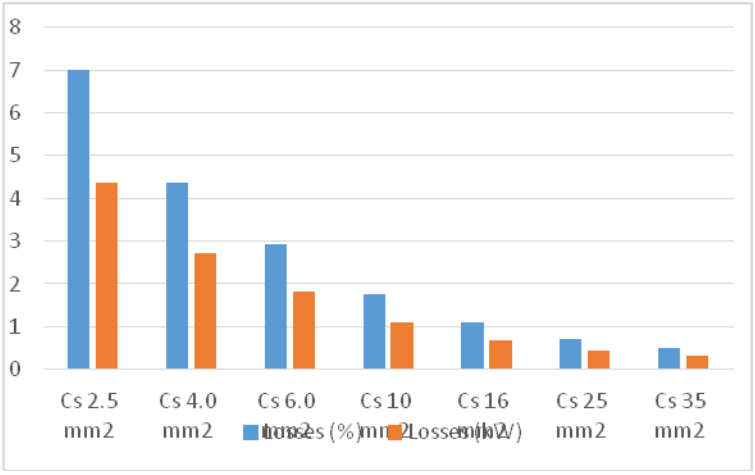
DC Energy losses		
DC Energy losses	W	70125
DC Energy losses	%	112.2

FIG 17. DC Energy losses

By using this calculation method, the cable diameter that leads to minimizing the power losses can be determined.

In the following, a sizing for a 62500W system in which the amperage is 125A, the material of the cable is made up of aluminum with a maximum temperature of 100°C and a length of 10 m. It will be shown in Graph 2 the importance of choosing the thickness the cable and how it affects the loss of electricity. Tabular calculations rendered the following values:

- Cable diameter of 2.5 mm^2, DC power energy loss of 6,996% (4372.5 watts)
- Cable diameter of 4.0 mm^2, DC power energy loss of 4.37% (2732.82 watts)
- Cable diameter of 6.0 mm^2, DC power energy loss of 2.92% (1821.88 watts)
- Cable diameter of 10 mm^2, DC power energy loss of 1.75% (1093,125 watts)
- Cable diameter of 16 mm^2, DC power energy loss of 1.09% (683.20 watts)
- Cable diameter of 25 mm^2, DC power energy loss of 0.7% (437.25 watts)
- Cable diameter of 35 mm^2, DC power energy loss of 0.5% (312.32 watts)



Graph 2. Energy losses according to solar wire cross section (for a 62.5 kW solar installation)

5. CONCLUSIONS

For increasing the efficiency of electric cars charging in the paper are presented the premises for photovoltaic electric current generation and two calculators, for AC and DC current solutions that are helping in optimal dimensioning of the charging cables. The technical optimization will be followed by the management of COTS (commercially available off-the-shelf) solution in order to ensure also the economic efficiency.

By presenting this method of supplying electric vehicles, we offer a solution to a detected problem: the loss of energy due to the electric cables used for both AC and DC.

From a technical point of view, cables that fits and falls within the tolerance of 1-3% for an AC are:

- 6 mm^2, recording energy losses of 2.20%
- 10 mm^2, recording energy losses of 1.32%

From a technical point of view, cables that matches and falls within the tolerance of 1-3% for a DC system are:

- 6 mm^2, recording energy losses of 2.92%
- 10 mm^2, recording energy losses of 1.75%
- 16 mm^2, recording energy losses of 1.09%

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ASPECTS REGARDING SOME WAYS OF DIFFERENTIATED USE OF TEACHING MEANS IN THE MATHS COURSES

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Abstract: *This paper aims at highlighting several aspects regarding the didactic means in terms of their use as a differentiated training strategy for Linear Algebra and Analytical and Differential Geometry courses and seminars. Thus, it is emphasized the importance of the differentiated use of didactic means in the differential treatment of students, some ways of using the didactic means in the courses and seminars are analyzed and exemplified. The paper concludes with the conclusions of the study.*

Keywords: *didactic means, differentiated use*

1. INTRODUCTION

"Inventory of traditional techniques of education and training in Mathematics has been reduced, until recently, to verbal means, chalk, blackboard, pencil and notebook. The palette of these means has expanded considerably, including audio-visual equipment, inclusive the computer, which amplifies the classical possibilities of teaching and learning Mathematics. Today, this process is increasingly under the influence of the technical means of training, designed to increase its efficiency, to facilitate it. It is not possible to conceive today an improvement in mathematical education activities, without ever increasing use of technical means of training. "[1]

"Usually a good professional in the field has also an extensive information complementary to the technical knowledge in the field. Moreover, if the technical aspects are accessible to specialists, the "cultural" ones can receive virtually anyone no matter their specialty. [2]

This "complementary information" is obtained during the faculty, whenever teachers at courses or seminars call for additional bibliography.

"Teachers must select teaching resources so that they can organize attractive and accessible activities, and by their proper choice they can better achieve their goals." [3]

"Differentiation and individualization of education is an old, but always present pedagogical problem, because people differ from each other not only in their way of thinking and being, but also in their capacity and rhythm of learning, their attitude to this one".[4]

Working differentiated with students in Math courses and seminars involves choosing the scientific contents and the training strategies appropriate to their teaching - learning - evaluation according to students possibilities and particularities, and this also means the differentiated use as didactical means.

2. THE IMPORTANCE OF DIFFERENTIATED USE OF DIDACTIC MEANS IN LINEAR ALGEBRA AND ANALYTICAL AND DIFFERENTIAL GEOMETRY TEACHING

"Eliminating the admission exam at most universities has created situations where, at courses they meet from art high school graduates, to laureates of school Olympics. Presenting attractive courses in these conditions is a challenge to scientific research." [5] So, in the current polytechnic higher education, in the vast majority of the groups there are both students with a low level of knowledge at mathematics and students with an average level, or with a high level of knowledge in these disciplines.

Regardless of the level at which the students are, or from which they start, the teacher has to do his job and always find the most useful ways for both the low-level and the high-level to be involved both in the activity at the seminar. Under these conditions, he will increasingly place emphasis on differentiated teaching, this assuming the differentiation of content, but also the differentiated use of methods and didactic means.

Differentiated use of teaching means in math lessons is an important resource in differentiated training. It gives each student the opportunity to learn in his own style. With the help of didactic means used in math courses and seminars, students are able to imagine the abstract theoretical notions, to link their math knowledge to their life experience, to integrate them into "their mathematical dowry," even to enrich them and not just memorize them.

Using non-differentiated means of teaching in the differentiated training of students in mathematics, situations such as those described below can be reached: students who have a high level of knowledge at the discipline announced, the unitary use of the didactic means leads them to boredom, that is for them the activity carried out with the same didactic material is too low, as well as for the students who have a minimal level of knowledge, the unitary use of the didactic means can lead to the further removal of these discipline, ie for them the activity carried out using the same didactic means should be too high and thus do not cope with the requirements. For this reason, during the design of courses and seminars, the teacher has to choose differently, if necessary, the necessary didactic means, so that all the students of the year or of the group can be integrated within them, in order to reduce the level differences between them.

Differentiated use of all mathematical training strategies aims at maximizing the intellectual potential of each student, causing him to overcome his fear, even his own limits sometimes, and to become an active participant in his own training, some of them even get performance.

Didactic means have a greater differentiated use in the courses and seminars of Analytical or Differential Geometry, as it is specific to these discipline to use more didactic means, indispensable in the training for students of the geometric notions.

And last but not least, didactic resources should sometimes be used in a differentiated way so that the teacher can more easily achieve the proposed objectives for all students in the group or the year respectively.

Differentiation of didactic means is an ever-present problem because students differ between themselves both in their own way of thinking and their ability to concentrate, by their attitude towards learning, but also by their own rhythm and style of learning, by hereditary dowry, etc.

3. MODALITIES AND EXAMPLES OF DIFFERENTIATED USE OF DIDACTIC MEANS IN LINEAR ALGEBRA AND ANALYTICAL AND DIFFERENTIAL GEOMETRY TEACHING

Differentiated treatment of students at Linear Algebra and Analytical and Differential Geometry courses or seminars, using also differentiated didactic means, can be achieved both in the teaching and learning process, as well as in their evaluation. Meaning, the didactic means can be differentiated used in these disciplines both in the courses and seminars of acquiring new knowledge, but also in the lessons of skills forming, or in the lessons of recap and systematisation or in those of assessment.

Less often in a course, but more often at seminars, didactic means can be used differentiated in an event of the lesson, or sometimes in two or throughout the activity. In this regard, they can be used differentiated to catching the attention, refresh knowledge, achieve performance, provide feedback, guide the learning, and even for the homework.

It can also be found that the lesson is designed without the didactic means being differentiated, but due to unexpected situations, individual support can only be provided to students who request it, i.e. those who do not meet the requirements of the lesson.

The design of Linear Algebra and Analytical and Differential Geometry courses or seminars, in which didactic means have been chosen for their differentiated use can be done in many ways, all in the idea of obtaining more in-depth feedback that allows the teacher to intervene promptly to help them progress both to the students who have a high level of knowledge in these subjects as well as those with a lower level.

Differentiated use of didactic means is in most cases in close connection with the differentiated use of methods and procedures used in courses or seminars, but also with the differentiation of scientific content. However, there is also the possibility that differentiated use of didactic means can be done without the differentiated use of the methods and procedures used less frequently, even without the differentiation of content.

Here are some examples of differentiated using of didactic means in the Linear Algebra and Analytical and Differential Geometry courses or seminars, that can be selected for their achievement.

In order to make a first classification of the students, the initial evaluation can be done with assessment sheets on two level groups, if there are students in class who have tested mathematics of different level of difficulty at baccalaureate.

A very common way of using differentiated didactic means is the usage of work sheets having different level of difficulty. Thus, in the Linear Algebra seminar, with the theme: "Vector spaces, subspaces, operations with subspaces ", teacher can formulate three work sheets with questions, with varying degrees of difficulty:

For students with a low level in Linear Algebra

1. What algebraic structures learned in high school do you know?
2. What is understood by the commutativity of a composition law?
3. What is understood by the distributivity of scalar multiplication with respect to the addition of vectors?
4. What operations with subspaces do you know?
5. What is the null space?
6. What is meant by the canonical basis of arithmetic space?

For students with a medium level in Linear Algebra

1. What is a vector space? Exemplify.
2. What is meant by supplementary subspaces?
3. What is the subspace spanned by a nonempty subset of a vector space?
4. What is meant by a vector subspace? Exemplify.

5.What is meant by bases and dimension in a vector space? Exemplify.
6. Which is the theorem of the change of basis?

For students with a high level in Linear Algebra

1. What supplementary subspaces do you know?
2. What theorem about the sum of two subspaces you know? Exemplify its use in a category of exercises.
3. What is the necessary and sufficient condition for the sum of the two subspaces to be direct? Exemplify a category of exercises whose sum is calculated with this theorem.
4.What theorem about the subspace dimension do you know and for what purpose you can use it?

A modality of using differentiated didactic means at the course, can be three notes with project' subjects. The subject, taught in high school, for the students who are left behind in these branches of mathematics, can be about the conics on canonical equations and the straight line in plane. The project' subject for middle level students, can be to study a theoretical theme, complementary to the theory taught at the course, with the title : Plane curves often used in the technique: definition, properties (without proofs). The theme of the project for high level students, can be: to study the Titeica and Bertran curves: definition, properties (with proofs).

Individual support can only be provided to students who request it. A such example from the Analytical Geometry seminar on "Conics on general equations" is described below. After a few conics exercises solved on the board, the teacher give the students independent work, to reduce the equation of a conics to the canonical form and then to represent it graphically. All students who did not have in high school math curriculum: study of conics on canonical equations, received a basic information sheet in order to represent graphically the determined canonical equation. Students who graduated from the Mathematics and Computer Science section don't need such a sheet in solving the exercise.

Another example, during the seminars of differential geometry, students with a lower level of knowledge at mathematical analysis receive a sheet with the formulas of derivation of elementary functions and with the primitives of elementary functions, while students with a high level of knowledge, did not need extra didactical means.

Another way of using differentiated didactic means is the election from problem books of problems corresponding students' level of knowledge.

A such example met in several Linear Algebra and Analytical and Differential Geometry seminars on different topics is the followig: in order to achieve feedback through independent work, the teacher conceives two work sheets containing problems with varying degrees of difficulty, namely: for students with a lower level of mathematics knowledge, a sheet with simple problems, and for other students, the worksheet contains problems with medium or high difficulty level.

For example, in the Analytic Geometry seminar, with the theme: "The Euclidian Space of Free Vectors", the two work sheets are:

Sheet A, (Lower Level)

1.The vectors are given:

$\bar{a}$, $\bar{b}$ şi $\bar{c}$ cu $\|\bar{a}\|=1, \|\bar{b}\|=2, \|\bar{c}\|=3$, $\sphericalangle(\bar{a},\bar{b})=\frac{\pi}{3}$, $\sphericalangle(\bar{a},\bar{c})=\frac{\pi}{4}$, $\sphericalangle(\bar{b},\bar{c})=\frac{\pi}{6}$.

Calculate the vector norm $\bar{a}+\bar{b}-\bar{c}$.

2.Let: $\bar{r}_A=2\bar{i}+\bar{j}+\bar{k}$, $\bar{r}_B=-5\bar{k}$, $\bar{r}_C=\bar{i}+3\bar{j}-\bar{k}$, $\bar{r}_D=\bar{i}-\bar{j}+2\bar{k}$, be the position vectors of points A, B, C and D. Determine: the scalar product of the vectors $\overline{AB}$ and

$\overline{AC}$, the vector product of the vectors $\overline{AB}$ and $\overline{AC}$ and the mixed product of the vectors $\overline{AB}$, $\overline{AC}$, $\overline{AD}$.

Sheet B, (Higher Level)

1.The vectors are given:

$\bar{a}$, $\bar{b}$ şi $\bar{c}$ cu $\|\bar{a}\|=1$, $\|\bar{b}\|=2$, $\|\bar{c}\|=3$, $\sphericalangle(\bar{a},\bar{b})=\frac{\pi}{3}$, $\sphericalangle(\bar{a},\bar{c})=\frac{\pi}{4}$, $\sphericalangle(\bar{b},\bar{c})=\frac{\pi}{2}$. Calculate the parallelepiped volume built on the representatives by oriented segments to the common origin of the three free vectors.

2. Points A (1, -5,4), B (0, -3,1), C (-2, -4,3), D (4,4, -2) are the vertices of a tetrahedron. Calculate the height of the tetrahedron from vertex A.

Other modalities of using differentiated means of teaching at Linear Algebra and Analytical and Differential Geometry seminars appears when using variants of interactive methods, such as "Gallery tour", "Jigsaw", "RAI", "Cube"., etc., as differentiated training strategies, the teacher has to draw up differentiated work sheets or differentiated theoretical subtopics, or even two sets of materials with varying degrees of difficulty.

Such an example is found in the case of the interactive method: "Jigsaw" , used at the seminar on the theme: "Eigenvalues, eigenvectors", where after solving various problems in this unit of learning, in order to obtain the feedback, the group can be divided into three homogeneous subgroups, depending on the knowledge of the students in the Linear Algebra, each subgroup having the task to solve a problem-a subtopic from the expert worksheet, corresponding to his level of knowledge.

The expert worksheet for the seminar: "Eigenvalues, eigenvectors" is given below.

Subtopics of expert worksheet:

1. Exercise to determine the eigenvalues of a matrix A or a linear transformation T. (Low level)
2. Exercise to determine the inverse matrix and the value of a matrix polynomial using the Hamilton-Cayley theorem. (Medium level)
3. Exercise to determine the diagonal form a matrix and the basis corresponding to the diagonal form. (High level)

Another example of using differentiated didactic means at the Analytic Geometry seminar on "Plane and straight line in space," is the following: students are asked to demonstrate using a drawing on an A3 sheet and colored pencils, the formula: parallelepiped volume = 6x the tetrahedron volume as follows: lower-level students demonstrated this formula on the particular case of the rectangular parallelepiped, and students with a higher level of knowledge, demonstrated this formula on the general case of parallelepiped.

Another example from the Analytic Geometry course about "Quadrics", for students to be motivated to learn and to see the applicability of the taught subject, thus linking the situations encountered in life and what was taught in the course it was completed by presenting with video projector numerous buildings, bridges, railways, in which some of the quadrics were used. In order to achieve a continuous and differentiated assessment of the students' knowledge of quadrics, each student was asked to bring such examples in the next hour of the seminar to identify the quadrics learned.

Each student have to identify two of the quadrics learned in the pictures and presented some of their properties as follows: for lower- level students the quadrics are: the sphere and the ellipsoid, for middle- level students the quadrics are: the cone and cylinders, and for higher level students, the quadrics are: the hyperboloid of one sheet and the hyperbolic paraboloid.

At some of the Linear Algebra and Analytical and Differential Geometry seminars, the homework can be given using two work sheets with problem having two level of difficulty, thus, students will be given a set of problems to solve, whose degree of difficulty corresponds to their level of preparation for algebra or geometry.

4. CONCLUSIONS

Upon entering college, there are great differences between math students 'knowledge, so that the differentiated use of didactic means is absolutely necessary, contributing to students' progress in these disciplines. The success of a course or a seminar depends also on how the teachers use the didactic means during their lesson.

It is natural that when the teaching of mathematical notions is done using differentiated scientific content, or differentiated procedural resources and didactic means to be used differentiated too.

Using didactic means at both courses and seminars of Linear Algebra and Analytical and Differential Geometry, as a differentiated training strategy, can be done in any kind of lesson and at any event of it.

If in the Linear Algebra and Analytical and Differential Geometry seminars or courses the didactic means are also used differentiated, then the chances of achieving faster the objectives proposed for the lesson increase, thus improving the activity.

There are certainly many other variants of using differentiated didactic means, the choice of one or other of them depends both on the situation in the classroom, the theme of the seminar or course, and the talent of the teacher.

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SOCIAL LEARNING AND THE STUDY OF QUADRILATERALS

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Abstract: *Starting on the motto: "Teaching others makes them richer, yet without you becoming pourer..." (indian saying) and not losing from sight the ideea that social studying presumes the adaptation of the educational act to the limits and posibilities of the pupil in general, and conveys to the style and rythm of studying of the pupil, to the interests to each abilities. This creates a way of drawing children closer to school, especially building more interest towards mathematics.*

In the world of information explosion, by treating the pupil in a differentiated way, one can create the motivation of learning by increasing school satisfaction.

Social learning, through its particular forms of organization, ensures an increased efficiency of social training, in order to allow students or pupils to select, organize and transform the stimuli that act upon them, thus making it possible to leap from training to self-training and from self-education to education.

Keywords: *social studying, modeling, education, efficiency, qudrilater, convex.*

1. INTRODUCTION

In the development of education sciences, model-reality analogies are research strategies of great importance, often necessary to know the phenomena and processes manifested in the educational environment and implicitly the didactic act, offering a field of validation, improvement or restructuring of various learning methods.

Interactive training strategies that harness group and microgroup relationships as permanent resources for learning, training and social education take place at this level.

An example in this sense is the modeling method based on analogical reasoning that capitalizes on the pedagogical resources of the training. Thus, certain complex behaviors formed in the training act can only be produced using modeling.

Modeling, in simple terms, is a process of knowledge based on a tool with special features, called model. In turn, the model represents an object that has the typical attributes of a category, intended to be reproduced. At the same time, a model can be a simplified representation of a process or system. [9, 10, 11, 12, 13]

The model of social training rejects some alternative concepts that consider the individual as a passive expression of unconscious impulses generated by the past or spontaneous reactions to environmental events.

On the other hand, the *model of social training* is delineated by the models promoted by the theories of personality and education that emphasize the importance of internal factors up to the exclusion of the role of the environment. These theories are rejected because they ignore the social responses of the educated person in various contextual situations as well as the determinant formative resources of quality education designed in the perspective of lifelong learning.

Similarly, the *model of social training* is delimited by theories that emphasize the role of external factors to the exclusion of internal factors. These theories do not have the capacity to capitalize on the cognitive functions of human behavior that constitute the educational psychological resources of education. [14, 15, 16]

The model of social training therefore rejects any excess or unilateral vision in addressing the personality of the educated person, and in conceiving the education as a postulated quality education. The social theory of learning highlights the fact that behavior can be explained only in terms of interaction between the person and the environment. This process is defined by Albert Bandura through the concept of mutual determinism, a concept that we can interpret from a pedagogical point of view as an open relationship between the educated and the entire educational environment. Those who learn are influenced by environmental forces, but at the same time have the freedom to choose how to act on a cognitive, affective, motivational, volitional and characteristic plan. At the same time, he actively and proactively builds cognitive and noncognitive solutions for various situations. [9, 10, 11, 12, 13]

The social theory of learning underlying the psychological model of social training implies specific notes and characteristics:

– to highlight the role of the educated as an epistemic subject (Piaget), respectively as an agent (Bandura);

– overstretching the social origins of behavior as effective training resources;

– revealing the importance of cognitive processes in the development and functioning of personality in complex, diversified and differentiated social contexts;

– emphasizing the importance of the systematic research activity of the social personality, the social environment and the relations between the internal individual resources and the external environmental social conditions (natural, economic, family, cultural, political, community);

– promoting at the level of learning complex behavioral models that act in the present, but also in the absence of explicit or implicit reinforcements.[3, 10]

2. ANALYSIS OF THE SOCIAL TRAINING MODEL

Consequently, the social training model will take into account the general paradigm level and the specific level of some paradigms. Thus, on a general level, the structure of the model generated by general didactics (training theory and methodology) will be considered. At a specific level, the social training model will refer to the social theory of learning as the psychological paradigm of learning with which pedagogy enters into interdisciplinary relationships.

A. At the level of general didactics (Theory and Methodology of Training)

At the level of general didactics the design of the pedagogical model has the following levels:

1. Basic structure
2. Organization structure including organizational forms
3. Planning structure
4. Structure of achievement

1. **Basic structure**

The teacher-student correlation is the central element of this level. This correlation is achieved at the formal level - the class of students, by groups and individually - and is objectively ensured by the permanent multidimensional exchanges that must exist between teacher and student.

The teacher is responsible for ensuring this correlation from the perspective of social training; He specializes in making these correlations as a specialized professor of social education, specialized in education through various subjects (mathematics, language, drawing, history, physics).

From the perspective of social learning at the basic structure of the general didactic model, the professional model generated, maintained, promoted, and imposed by the teacher becomes achievable. At the level of the general professional conduct, the professional model provided by the teacher ensures the possibility of extracting by the students specific follow-ups regarding the general professional attitude, the impact of the competences on accomplishing immediate personal goals, the types of persuasion, the transmission of messages, the reasoning , energizing and affective-emotional engagement.

The student is the beneficiary of this correlation that contributes to the formation and development of social skills and his / her personality towards social integration. It integrates the element of the teacher's professional model through observer learning, learning determined by the social aspect of the relationship between him and the teacher. In this perspective in experimental learning, the behavioral, cognitive and non-cognitive model proposed by the teacher becomes extremely important.

The conversion of the teacher from the professional didactic to the professional model is achievable by understanding, internalizing, and capitalizing on the concept of mutual determinism, which means that both students and the educational environment are determinant factors that influence each other. In this context, effective learning is determined by the quality of social interaction between the teacher, student and the educational environment. The student is influenced by the forces of the educational environment, the social relationship with the teacher, but at the same time it has the freedom to choose how to act on cognitive, affective, motivational, volitional and characteristic plan. He responds to different situations in the educational environment, but at the same time, he reactivates, actively and proactively, his own cognitive and non-cognitive solutions for various situations with professional openness, in this case.

2. **Organization structure including organizational forms**

The organizational structure supports and is determined by the basic structure. It involves the proper organization by each teacher of the resources he has at his disposal:

- information (plan, programs, manuals, auxiliaries);
- human (teachers and pupils with their individual and social qualities and defects. Here are other factors of education directly or indirectly involved: auxiliary staff, parents, representatives of the local community);
- didactic-material: the time and space during which the training takes place in the school and outside the school.

The whole layout of the organizational structure from the perspective of the social training model is strongly socially imprinted. In this way the importance of the systematic research activity of the social personality, the social environment and the relations between the internal individual resources and the external social environment conditions (natural, economic, family, cultural, political, community etc.) is taken into account.

Forms of organization

a) General Forms:

- formal training (lesson, university course, etc.)
- Non-formal training (specialized circles, individual study, consultations, technical research circles, training courses and personal development, etc.)

The model of social training has in mind formal training to identify and promote socially desirable social models while, through non-formal learning, the models are diversified, emphasizing the role of the educated person as an epistemic subject (Piaget) or act agent (Bandura);

In this new hypothesis the training takes place in the absence of explicit or implicit reinforcements, being determined by the informative and formative functions of the models.

b) Particular forms:

- front-class training with the class of students
- group training (within or outside the school curriculum)
- individually (within the class or outside of the school curriculum).

Typical concrete forms are the lesson for pre-university education and university education for higher education. Particular forms of organization provide increased efficiency of social training to enable students to select, organize and transform stimuli that act upon them, thus influencing their own behavior. Through these self-generated influences, cultivated by the model of social training, the leap from training to self-training, from education to self-education is ensured.

3. Planning structure

The planning structure takes into account the following objectives: the value guidelines proposed by the teachers (at the level of the lesson or the authors of the curriculum at the general and specific level).

a. The basic contents of the social training model include science, arts, technology, skills, problem-solving strategies, social learning in curricula at the educational disciplines level.

From this perspective, we are able to make a few judgments about the shortcomings of the learning unit called the quadrilaterals found in the 7th grade alternative textbooks:

- no manual contains the definition of the convex quadrilateral, the ways of recognizing it, although all the quadrants provided in the curriculum are convex and possess its angled property;
- in a single handbook of the three parallelogram definition, it follows that it is a convex quadrilateral;
- in the case of parallelogram and particular parallels, the properties are not specifically specified, much less exemplified on the drawing. These are given in the form of necessary and sufficient conditions, so there is no clear distinction between the necessary and sufficient properties and conditions;
- even in the definition of the trapeze does not appear any connection with the convex quadrilateral and in a single manual there is a detailed description of the elements of the trapezoid (bases, unparallel sides, height);
- in one of the textbooks there are not listed the properties of the isosceles trapezoid, and in the same manual there is no mention of the axes and the centers of symmetry of the quadrilaterals.

b. Teaching methods are the ways of action proposed by the teacher in class or outside the class for the effective realization of social training: conversation, demonstration, discovery discovery, lectures, exercise, programmed instruction, didactic play, etc.

c. The development strategy respects the requirements of the general model in the training theory and methodology:

- strategy of initial evaluation with diagnostic and predictive function;
- strategy of continuous evaluation, with formative function;
- the final evaluation strategy with a cumulative summative function.

4. Structure of achievement

The implementation structure is aimed at implementing three-step planning:

a. Teaching: or the pedagogical communication of the didactic message by the teacher (it is designed according to the didactic principles, it includes the selection of some information that will lead to the correct formation and development of the pupil). It must be done at the level of understanding, motivation and affectivity of the student.

b. Learning is the pupil's action based on surrender. It assumes several stages of reception, internalization and capitalization of the message (active reception, passive, affective, cognitive, motivational internalization, short, medium, long, discipline applicability, intra, inter, pluri and transdipinar, reproductive applicability or creative).

c. Assessment is conducted by the teacher through various methods (classical - based on oral, written or practical evidence) or alternatives (based on observation, self-evaluation, investigation, project, portfolio); It aims at verifying the degree to which the objectives of the social training activity transposed at the level of learning-teaching actions are met.

From the alternative methods, I chose the Method of String, and Venn Diagram

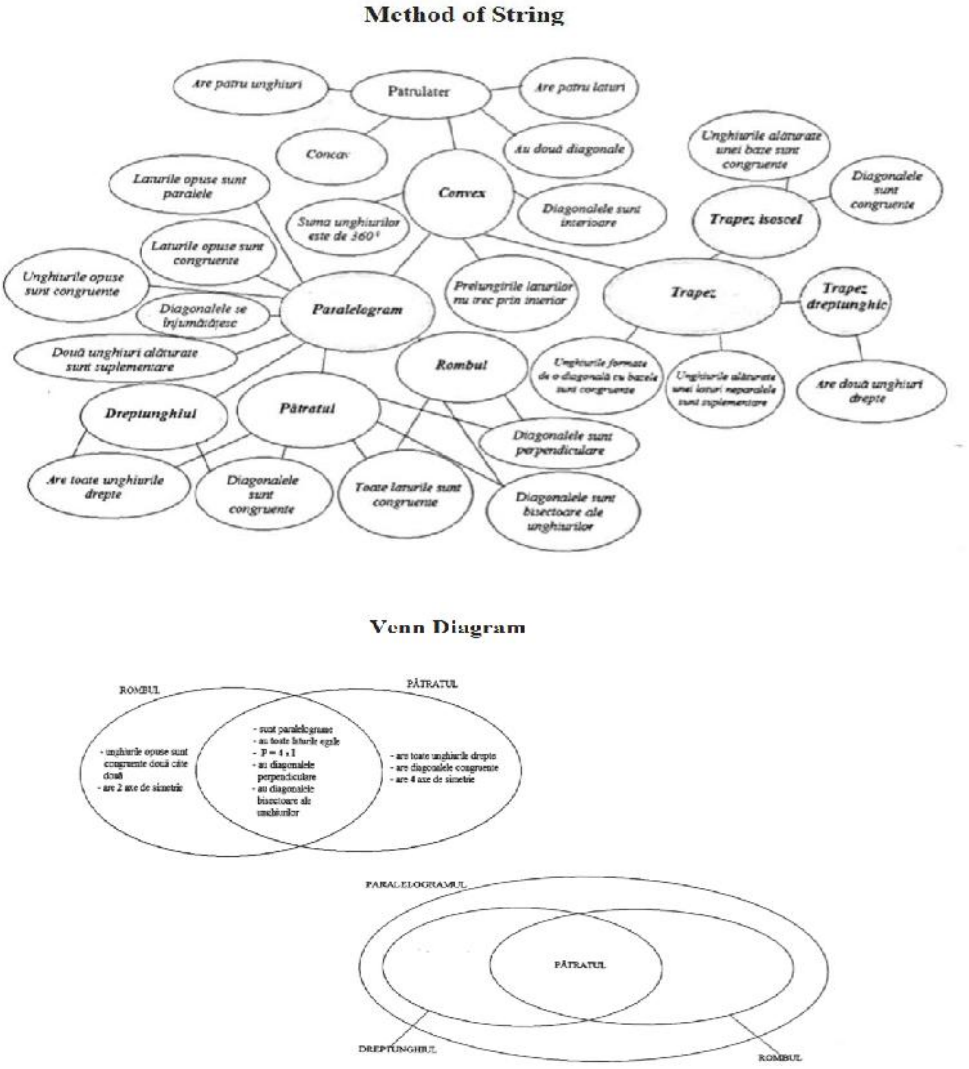

FIG.1 Analysis of the social training model at the level of the curriculum paradigm

The paradigm of the curriculum tries to solve the conflict between the two paradigms of modern pedagogy, launched at the border between the 19th and the 20th century, which are currently facing.

The paradigm of psychological or psycho-centered pedagogy is centered on the psychological requirements of the educated person.

The paradigm of sociological or sociocentric pedagogy is centered on the demands of society towards education or the educated person (economic, political, cultural, community, etc.).

The paradigm of the curriculum as the paradigm of post-modern pedagogy (the second half of the 20th century) attempts to solve the conflict between the two modern pedagogues, emphasizing the ends of education (the ideal, aims and objectives of education-training) built on the interdependence of the psychological requirements the paradigm of psychological pedagogy) and the demands of society (emphasized by the sociocentric paradigm).

The model of social education, developed in the curriculum paradigm, contains certain requirements. Psychological requirements are expressed through competencies and capabilities, and social requirements are expressed through basic content recognized by society (from the curriculum).

1. Basic structure of social training: emphasizes the permanent reconstruction of teacher-pupil correlation required in pedagogical and social context. Both the teacher and the pupil have the task of communicating the changes in an open context and of rebuilding the relationship between them actively, influencing the educational environment and being influenced by it permanently.

2. Structure of organizing pedagogical resources in different forms:

a. ensuring the individualization of social training in any imposed form of organization (classes with 35 pupils) or chosen by the teacher (group organization) to achieve the objectives of social training.

b. Individualisation of social training - making the most of each pupil's resources (cognitive, non-cognitive, social related to the social, family, and social learning capacity, and previous school results).

c. ways to achieve the individualization of social training - knowing the pupil; graduation of concrete objectives; diversity of methods; optimal blending of training.

3. The structure of social training planning

It involves focusing on objectives and basic content specific to social learning, concordance between all components of planning, strategy of continuous formative evaluation with the aim of regulation and self-regulation of activity.

4. The structure of what has been planned

It is done in an open social and educational context. It requires development and development in relation to the responses to the open social and educational context. There is a permanent interdependence between the three actions: teaching-learning-continuous assessment (the continuous evaluation strategy is based on the combination of classical and alternative methods, resulting from the social learning model based on social learning theory).

3. THE MODEL OF SOCIAL TRAINING

1. Basic structure: the correlation between the educated person and the teacher-student relationship is achieved through mutual determinism in the open educational and social environment, favorable to observational and experimental learning.

2. Organizational structure: It is operational through general, nonformal, private social learning forms at group level, based on observation, experimental research, identification of qualitative models through available resources (information, formative, human).

3. Planning structure:

It aims at achieving the social objectives of social training:

- training of social skills;
- training of identifying and recognizing social desirability models;
- training and exercising observer learning skills;
- stimulating critical, selective, heuristic, non-linear and analytical thinking needed to evaluate critical models and critical experiences;
- methods used: direct experiment, observation, hypostasis or role play, case analysis, etc.

4. Structure:

Applicability through social verbal learning, teaching at the level of effective social communication on school group, microgroup, additional social learning, assessment of the effects of initial and ongoing evaluation.

The model of social training operates with the following concepts:

1. Training is the pupil's training / development activity, based on the permanent correlation between the teacher and the student according to the objectives of the teaching process through teaching / evaluation.

2. Learning is interpreted pedagogically as an action subordinated to teaching activity along with teaching and evaluation. It does not have its own objectives, which are taken from the objectives of the training or the educational process. Instead, he has his own motivation, which consists in acquiring knowledge, skills and attitudes.

3. The psychological model of training is achieved through the pedagogical interpretation of A. Bandura's social theory of learning. Psychologically, learning is a psychological activity with the purpose of adaptive finality. At pedagogical level, learning is subordinated to the training activity.

4. CONCLUSIONS

1. To believe in giving up new ideas for a return to traditional mathematics is to show total ignorance (not allowed for those who embrace such an opinion). On the contrary, we believe that there is not one true mathematician who admits that the present state of his knowledge is a definite one.(Andre Revuz, Ed. Didactics and Pedagogy, 1970).

2. The model of social education centered on social learning addresses training in terms of mutual, continuous, uninterrupted interaction between cognitive, behavioral and environmental determinants. This is the psychosocial foundation of education with openness to self-education.

3. Student-centered active and interactive methods and techniques contribute to the development of critical thinking, actively involve learners in learning, putting them in the position of making logical connections and transforming traditional activity into a lifetime of easy passage to the car -training and self-education.

4. The model of social training aims to explain the students' behavior and understanding from the perspective of the need for social efficiency, treated as a potential pedagogical resource. The students' potential to influence their own behavior in the most general sense marks the lines of a pedagogical process of self-development - self-development circumscribed to the concept of mutual determinism launched and imposed by Bandura.

5. The social training model emphasizes the development of cognitive competences, expectations, goals, standards, self-esteem, and self-regulating functions, both through observational learning and through direct experience. Achieving goals through learning from personal experiences in the educational environment and from the models promoted through this environment determines a strong intrinsic motivation for learning and social success.

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PRELIMINARY STUDY ON CAREER COUNSELING NEEDS OF HIGH SCHOOL STUDENTS

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Abstract: *Both choosing the academic specialization and the vocational path need an active, self-consciousness and especially responsible engagement of the adolescent, this making the individual to self-evaluate from the personal values, skills, abilities, and interests point of view, to explore the available opportunities and to make the right decision so that he could answer to the two important questions: "Who am I?" and" Who/What do I want to become?". The present study investigates the training and development needs of high school students both from a professional and personal perspective. The research was carried on a sample of 134 young people aged 16 years to 18 years. The analysis of the answers given by the participants highlighted mostly the need for self-knowledge, and the need of identification of the relationship between own personality and job characteristics. The necessity of the implementation of a multidimensional career training program is discussed. The career counselling programmes should include both vocational orientation aspects and personal, cognitive and also emotional ones.*

Keywords: *needs of training, professional development, career choice, personal development.*

1. INTRODUCTION

The fast and major transformations which take place in our present society, both from technological, socio-economic and cultural point of view require a high level of the capacity of adaptation and integration of the individuals. Together with these transformations, there occur changes on the labour market and on the educational system from the perspective of the specializations offered/required, of the level of required experience, of the psycho-vocational profile. All these aspects influence the way that success or failures are perceived, the efficiency or inefficiency regarding the vocational activity. In this context, many high school students confront themselves with a major decision, regarding the educational and vocational orientation, the choosing of educational and vocational path. For the last years, at the international level it has been noticed a significant, even alarming increasing abandon rate in the higher education or the major changes of the academic specialization and even of the vocational orientation [6]. Considering that the studies have proved the efficiency of the career counseling, which are the actual training needs of the high school students so that the process of choosing the educational or vocational path could be improved?

2. PROBLEM STATEMENT

The transition from high school to higher education or to getting a job is extremely difficult, it requires extra efforts that the adolescent must make in order to adapt to his/her new status and to assume his/her new social role.

Many studies have proved some difficulties adolescents meet regarding the way they perceive their future career [5; 10], the way they plan and see their educational/vocational path after graduating the high school [2; 10]. Becoming aware of the importance of the decision regarding their educational or vocational orientation and also, the process of exploring the options in career become extremely stressing for the adolescents [12], Consequently, they ask for outside help, trying either to determine others to make the decision for them (parents, friends, teachers), or to postpone it as much as possible or to avoid it [4]. Moreover, they use inefficient criteria in their decisional process (e.g. keeping the group of friends). The Andersen and Niles study [1] underlines the high level of stress and negative emotions (anger, anxiety, frustration, lack of hope, discouragement) related to the decisional process [9]. There were also identified as predictors of the attitude towards making the decision, the level of self-efficiency, self-esteem, optimism [3], emotional stability, social adaptability [11]. The Code et al. study [8] identifies seven factors/ fears related to the difficulties meet by the adolescents in making a decision about their future career: formation and education, security/safety, satisfaction, risk of failure, responsibility, a bad choice of the career, making the decision. The exploration of the career options (educationally or vocationally) becomes an essential aspect in the formation and development of identity [7]. Thus, in order to increase the efficiency of the career orientation programs, we must start from the exploration and evaluation of the students' needs and not from the third-parties assumptions [5].

3. AIMS OF THE RESEARCH

The present study is part of an ample research work regarding the educational and vocational orientation of the young people, investigating the needs of the adolescents from the career choosing process point of view (adequate career and/or specialization of their next educational level). Thus, the present research represents a preliminary study which aims to highlight the type of the adolescent's training needs in order to facilitate the socio-professional or educational adaptation and integration

4. RESEARCH METHODS

The research was carried out on a sample of 134 students, selected from 4 high schools in Romania, with ages between 16 and 18: 79 boys (58.95%) and 55 girls (41.04%). The distribution of the test sample depending on the urban/ rural area where the high school lies is 43 rural (32.09) and 91 urban (67.91%). The participants are students in the 10th grade (23 students), 11th grade (49 students) and 12th grade (62 students). In order to identify the main formative and development needs of the high school students they were given a questionnaire with 12 items regarding the educational or vocational path option, rated on a Likert scale, in 5 points. Although, the questionnaire aim was an exploring one, the 12 items were divided into 3 factors in order to identify as exactly as possible the students' needs: the need of self-knowledge (interests, values, personality, etc.), the necessity to identify the proper occupation/specialization (the relationship between the personal profile and the specific of the occupation/specialization) and the need of practical support (preparing the file, searching for information, etc.). The questionnaires were given at the beginning of the school year. After filling in the questionnaire, the students took part into a half-structured interview which targeted the evaluation of the three factors included in the questionnaire and in the same time offering the students the possibility to specify themselves their needs, regarding the educational or vocational orientation. The interview was individual and it lasted about 15-20 minutes.

5. FINDINGS

Following the analysis of the given answers by the participants, it has been highlighted that from 134 students, 105 of them, representing 78.36% consider that they need information regarding the occupation/academic specialization which fits them best, 82 (61.19%), need information about themselves, the lowest scores was obtaining by the items regarding the practical aspects about choosing their vocational or educational path (only 25 students, 18.66% considering they need support for elaboration of necessary instruments to get a job or to enroll at the university). There weren't significant differences between the answers given by the students from urban environment and the ones given by the students in the rural environment (86.04%, respectively 74.73%), both groups putting on the first place as importance the need to find out the proper occupation/ academic specialization. Although they know certain aspects of the specializations offered by the universities and of the different occupation, 78.36% from the respondents consider that they need support in order to identify the proper occupation for them. The qualitative analysis of the answers given by the students at this factor during the interview, underlined a low level of the trust in their own abilities in making the right decision, considering that „others must help me to make the right decision for me "or" I don't know if it is the right specialization/occupation for me", a high anxiety "many times, I am afraid that I didn't make the right decision for me". Very many answers of the students were related to their need of self-knowledge, clearly expressed with phrases like: "I wish I knew myself more" or "I don't know if I am well prepared for...". The difficulties met in knowing their own personality and in identifying the proper occupation for them are also underlined by the low level of the importance of practical aspects related to academic or vocational evolution, in this respect, students considering that they know (where, how) to look for the practical necessary information or they already know it but, they don't have the necessary abilities to relate them with their own profile.

CONCLUSIONS

This research is an exploratory one; it constitutes a starting point in order to elaborate a career counseling program addressed to the high school students, based on their actual needs, expressed clearly and directly. Being a preliminary study, it has as a goal the exploration of the students' needs, thus the statistical data processing are primary ones.

Analyzing the students choices, from the age particularities and their current educational level point of view, it may be noticed an interest towards self-knowledge and establishing a relationship between their own resources (interests, values, personality characteristics and their abilities) and the vocational domains, being highlighted the students wish to find out more about themselves for personal and professional development, in order to identify those occupations that fit best to their personal profile. There was also noticed an interest for career development and orientation both educational and vocational level. This interest was underlie by their need for information about the occupations and the opportunities they offer, about the requirements, the criteria and the standards necessary to get a job in that area, about the formative and developing ways in that specific occupational area. According to the obtained results, the elaboration and the implementation of a career counseling program must take into consideration the introduction of some activities to facilitate self-knowledge, both from the perspective of personal development and from the educational or vocational orientation, which should support the students in the process of making a career decision, according to their psycho-pedagogical and vocational profile.

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THE ROLE OF AIR FORCES IN CONTEMPORARY CONFLICT

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Abstract: *In recent years, due to the technical progress of the experience accumulated amid the evolution of the military phenomenon as a whole, the actions of the air forces have become more frequent and better organized, their place and role gaining new dimensions as it results from the experience of recent or ongoing conflicts. In this context, contemporary confrontations require the redefinition in the military art and the practice of armed struggle.*

It is obvious that most military actions have a common character, although their organizational and spatial components are not always clearly delineated. In this paper, we are considering the classification of forces according to the criterion of the dominant environment in which they act - the terrestrial environment with the land forces, the marine environment with the naval sheets, respectively the air space with the air forces.

As far as air forces are concerned, it is absolutely necessary to review and rethink the definition, missions and modalities of action.

Keywords: *air force, military conflict, air power, airspace security*

1. WHY IS AIR FORCE NEEDED?

For this, we should first see the framework within which they will act - the natural environment, but also the role they play in the political and military decision-making process of state actors, international security and defense bodies.

Airspace, as the dominant airspace of the Air Force, has its own specificity, making it more difficult to investigate. The dangers and threats it generates are even harder to anticipate and counteract. In this context, airspace should be seen as a medium of human activity, but also as an element of national territory, as a subject of public international law.

Airspace - the atmosphere, with specific physical properties, composition, structure and activities (meteorological) - has become, with the accomplishment of the flying machines, the medium of human activity. By its nature, it creates specific vulnerabilities including aircraft fragility, meteorological effects, environmental conditions of air operations, and the need to restore capacity. Aeronautical activity has developed at a rapid pace so that at the beginning of the second century of aviation the defining characteristics are spatial expansion, diversification and crowding of air traffic.

The evolution of aeronautics and the intensification of specific activities have raised concerns for establishing and clarifying the legal status of airspace. The 1944 Chicago International Conference, in which the International Aviation Convention was adopted, recognizes the States' full and exclusive sovereignty over the airspace adjacent to its land and sea. The state territory is bounded by borders within which the state exercises its full sovereignty. Airspace is therefore an element of the territory of the underlying states.

The establishment of state borders is made by delimiting and demarcating them - a political and legal operation to identify and describe the route and limits within the treaties concluded for this purpose.

Regarding airspace in public international law, it is shown that it consists of the air column above the ground and the water space of the state being delimited horizontally through the terrestrial, river or maritime boundaries, vertically up to the inner boundary of the extra-atmospheric space. In some works it is stated that the upper limit is 100-110 km. As a result, airspace as an element of national territory is bordered by the national airspace of the neighboring countries or, where appropriate, by the international airspace corresponding to the open sea, and in the upper part with the cosmic / extra-atmospheric space.

In 1967, the treaty was adopted on the principles to be respected in the field of exploitation and use of extra-atmospheric space. In the cosmic space, there are three main types of activities: - scientific research; - operational purposes (communications, weather, etc.); - space-operated and manned space flights. Freedom of exploitation and use of space does not allow the appropriation, the placement of nuclear weapons or other types of weapons of mass destruction or the use of the moon and other celestial bodies for military purposes.

State sovereignty over its air space materializes primarily through its right to establish the overriding legal regime over its own territory for both domestic and foreign aircraft. Each State governs its internal legislation the conditions for access to and use of its airspace and may prohibit certain military or civilian aircraft from entering that area.

Under these circumstances, the issue of state sovereignty in airspace addresses the following main issues:

- the delimitation of airspace (space);
- the applicability of international regulations;
- national airspace regulations,
- decryption and resolution of situations affecting airborne sovereignty;
- establishing institutions for the materialization of air sovereignty.

In order to manifest its sovereignty over the entire territory, the state needs the necessary capacity / force to supervise and act in the national airspace. The only forces capable of fulfilling these missions are the air forces.

2. WHAT ARE THE AIR FORCES?

A nation must identify, create and use all resources to ensure the sovereignty of the territory, to prevent any attempt to violate national airspace. In most papers, air power is said to be the ability to use airspace for military purposes or as part of military power.

As part of the power of a state, air power has a distinct role and, in our opinion, refers to all the forces and means of civil aviation, military aviation, specific infrastructure, and all terrestrial (and cosmic) forces and means for protection air navigation. We include here, also, the capabilities required to control air operations. Also, all aeronautical companies or those producing the technique or components used in aeronautics can also be considered here. We could say that air power represents the state and capabilities that allow the state to manifest its sovereignty in national airspace and air traffic, all the factors that ensure the smooth running of human activities in the air.

On the other hand, the power of a state can be analyzed from many perspectives, resulting in several components: political, economical, military, social.

In fact, the national power is materialized through a complex of knowledge, resources (forces and means) and actions that allow it to assert itself and to force its will against other state or non-state actors.

Mankind and its economic development have expanded into the air. Since its inception, the military has also been given military equipment, and the state has created a military instrument (to defend or impose its own interests in the airspace) military aviation and later the military air forces. But what is meant by air forces? In the light of previous considerations, the air forces present themselves as an element of the air power, but obviously of the military power, at the intersection of the two components of the national power (Fig.1).

The Romanian Army Doctrine, the 2012 edition, shows that "the Romanian Armed Forces' structure includes the army's forces - ground forces, air forces and naval forces - plus supporting commands, special operations forces and other forces ... ". The Air Force doctrine states that they "designate an important category of forces of the Romanian Armed Forces operating in and out of air space and integrates the actions carried out in this space by the other forces of the army." If we open the SMFA official website, we will find its mission "Defense of Airspace by air, air and ground-air, support of other forces and local authorities in emergencies". Google also shows us, in most cases, that the air forces represent the military aviation of the State Armed Forces. Therefore, the air forces are somewhere at the junction between the air power (in the broad sense) and the military power of the state.

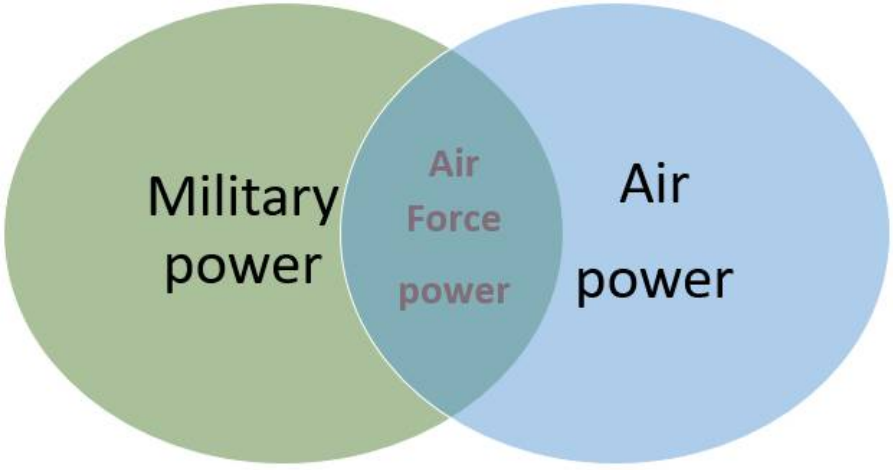

FIG. 1 The place of the Air Force power

We identify two aspects of the air forces. The former refers to air forces as those elements operating in and through air for the purpose of achieving specific military actions in and through this environment. Therefore, in the air forces, radiolocation as a means of airspace research, aviation as a flying platform, and air-to-air means of action against aircraft (artillery, missiles and radioelectronic means) are also included in the air forces.

The second aspect is to organize the army by force categories and thus meet the Air Force as a component of the structure of the military forces of a state. I recall the fact that most countries have the structure of their Air Forces as a distinct category of forces. At the same time, however, in many armed forces, including the Romanian army, there are means and forces capable of taking action in the air and other forces structures (land forces, naval forces). Sure, the destination and missions in the two situations are different.

If for the Air Force it refers to the sovereignty of the state in the national airspace and its representation in the airspace of interests, instead of the structures belonging to the other categories of forces the missions are limited to immediate, immediate and exclusive support.

This is clearly the role of the Air Force in the state's power equation. Understanding this, we will accept that under a certain aspect - that of managing and coordinating the activities carried out in the national airspace, the Air Force must play a leading role in ensuring the unity of action.

Each state has its own conception of organization and endowment of forces for armed struggle, conception resulting from the general policy of the state, based on its interests and possibilities. The stability of the categories of forces within the military system, their judicious proportionation, their role as well as the general and detailed organizational structures, the organization of the command, are considered.

3. AIR FORCES IN MILITARY CONFLICTS

Ever since the first aircraft, the military has intuited their usefulness in specific activities - observation, reconnaissance, liaison missions, and the Army has begun to acquire aircraft and prepare personnel for their exploitation. In a few years aviation has claimed to be a new weapon with the applications and maneuvers of many armies. History records that the first reconnaissance operations and first bombing missions took place at the beginning of the 20th century during the military operations carried out in the context of the 1911 Libyan colonization.

The First World War confirmed aviation as a distinct weapon in the army, highlighting new possibilities for the use of aircraft in the battlefield now and vertically expanded into the airspace.

In the interwar period, on the basis of the geopolitical background characterized by the preparation for a new war, there are theoretically outlined three orientations regarding the concept of aviation use in the war: - as an independent weapon, exclusively for the support of the land troops, respectively - used in co-operation with the land forces and the independent troops. In practice, the aircraft were specialized for certain missions.

In World War II, aviation has strengthened its role as the main category of military forces, indispensable in a war, able to carry out large-scale actions and decisive effects, with increased independence.

The conflicts that took place during the Cold War demonstrate the evolutionary nature of airspace operations through checks and nuances of theoretical concepts, by testing and refining the means of fighting in local wars, against the background of the ideological and political confrontations between the two superpowers USSR) and their allies.

The disappearance of bipolarism, marked by the fall of the Berlin Wall, also coincides with the prefiguration of a new, ultramodern war, exemplified by the Gulf War (January-February 1991), in which the strategic air operations highlighted the role of new warfare technologies and concepts. However, we note the fact that many military analysts regard this kind of unrepeatable war.

With the involvement of international organizations in new types of operations (other than war), the share of air force missions changes in favor of uncompetitive (airborne research and surveillance of the conflicting parties, humanitarian shipments or the immediate benefit of the forces in the area etc.).

Conflict in the air is, in the classic war, the confrontation between the air forces of the belligerents and is a major way to achieve success in the modern armed struggle.

Confrontation occurs between flying (air-to-air) means or between ground and ground flying (ground-air or air-to-ground) means. The purpose and objectives of the air force can be addressed from the perspective of the "beneficiary" and / or from the "performer" perspective. The place and role of the air forces, the size of the confrontation, are set at the level of the "beneficiary", and the content and physiognomy of the action is the preoccupation of the executor who must ensure the "fulfillment of the mission" in the concrete conditions of the confrontation. This approach can also be applied in the context of "non-classical" confrontations as well as in peacetime or crisis situations.

Air Force Destination - Defending state sovereignty in the national airspace and maintaining its integrity, gaining / maintaining control of a part of the strategic airspace, reducing the enemy's military potential and enhancing the effectiveness of other forces - corresponding to the context in which it operates. Thus, theoretical works, normative acts (doctrines, regulations, manuals) as well as experience in military action theaters (orders and plans of operations, lessons learned) highlight a very wide and diverse range of missions. By grouping these missions according to the particularities of the execution, the technical-tactical characteristics of the means used and the specifics of the training of the involved personnel, we can identify the following classes/ types of missions:

- aerial surveillance - research, discovery, identification and dissemination of information on aircraft and objects in flight as well as meteorological phenomena;
- hitting targets / targets in flight (aircraft, missiles);
- hitting surface targets / targets (land or water, including immersion);
- aerial research - research on a flight platform;
- air transport.

Accordingly, the forces and means involved may be: aviation, ground-to-air missiles, antiaircraft artillery, radiolocation. In turn, aviation can be specialized for air-to-air, air-to-ground, transport, research and radar locations can be on the ground, on ships or airborne. Also, missile and artillery striking means may be disposed on the land surface or on board ships.

CONCLUSIONS

As a conclusion, the size, content and physiognomy of aerial actions are given by the military component of air power, which is of major importance in the modern army struggle.

At the same time, the actions of the air forces acquire specific characteristics through speed of execution, mobility and freedom of maneuver. The speed of an aircraft allows the direction of air force action at key points and the timely operation of the time. Mobility ensures relative independence from terrestrial infrastructure elements and versatility in action. The freedom of maneuver offers the advantage of rapid adaptation, in real time, to the battlefield reality and the conditions of the target as well as the realization of the surprise.

The effects of air force actions are vital in the context of joint operations, including within collective security structures such as NATO. Air operations may be part of all three NATO military missions: Article 5 - Collective Defense; Non-Article 5 - Crisis response operations; Consultation/ cooperation. Moreover, air forces are a means to create and obtain a wide range of effects including engagement, coercive and disincentive activity at a tactical, operative and strategical level, most often at times when other elements of the armed forces can not fit.

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THE ROLE OF CONSTRUCTIVE SIMULATION IN THE AVIATION SECURITY MANAGEMENT

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Abstract: *The Airspace Security Management is a challenge at both operational and educational level. The "Henri Coanda" Air Force Academy has the mission to train future military specialists in a manner adapted to changing demands. Constructive simulation is one of the tools that, once integrated in the training curriculum, provides for students the skills needed to successfully operate in a complex, diversified and ever changing field. The JCATS software platform covers the full range of operational requirements specific to the air forces.*

Keywords: *constructive simulation, aviation security management, Air Tasking Order, Airspace Control Order, Integrated Air Defense System*

1. INTRODUCTION

The Airspace Management is a complex issue in terms of increasing demands for use, both for civilian and military purposes. NATO concerns (through the Air Traffic Management Committee - NATMC) and the EU (through the European Commission) focus on flexible use, cost efficiency, safety and security [1].

The competition for areas and operating time in peace conditions leads to an adaptation and continuous improvement of specific airspace control processes. For crisis and war situations, the existence of clear procedures for achieving the transfer of authority over the air space to the military factor is an incontestable necessity.

Through the implementation of the Single European Sky (SES) and the Flexible Use of Airspace (FUA), the EU aims to "accommodate operational requirements" [2] by applying the principle of equality (between civil and military aviation) within the Functional Airspace Blocks (FABs).

The Airspace Security Management is not a new concept, but it is very important to ensure that future specialists are the result of a training process focused on integrating into the operational work of the three components: live, virtual and constructive (LVC). NATO differentiates these components according to two criteria: the type of people operating systems (real, virtual or simulated) and the type of operating systems (real or simulated) [3].

Current defense investments create new capacities that, in order to meet the desired capabilities, need to be doubled by investment in education and training. The Romanian Air Force has understood these imperatives and initiated a process of curriculum reform in order to ensure that the future pilots, air traffic controllers and anti-aircraft racers are ready to become adaptive and agile thinkers.

2. PLANNING IN THE MILITARY DECISION MAKING PROCESS

In any civil or military organization, the decision-making process is known as the process in which it is decided *whether, when* and *what*. Also, the whole process involves the understanding of the consequences of taking decisions on each considered course of action. The decision is the instrument by which a commander transposes his vision into action.

The decision means both science and art. Some aspects of military operations (eg. the effect on the target) are quantifiable and, moreover, part of the science of war. Other aspects of military operations (eg. impact of leadership, enemy intent) belong to the art of war [4].

The decision process is a complex and complete process and has a number of advantages, such as:

- analyzes and compares multiple COAs - war gaming and the result is to identify the best, most effective and optimal course of action;
- produces integration, coordination, and synchronization in order to support operations and to reduce the risks of critical issues.

The major disadvantage of the decision-making process is the great time consumer, especially since the decision taken largely influences the military operations.

Commanders - regardless of the hierarchical level - are responsible for the decision-making process, and they decide on the procedures to be used on a case-by-case basis. In the literature, the stages of the decision-making process are well known, analyzed and detailed:

1. receiving the mission
2. mission analysis
3. developing the courses of action (COAs)
4. analysis of the COAs (war game)
5. comparing of the COAs
6. approval of the course of action
7. approval and issuance of the action order

The simulation of the decision-making process aims to prepare the commanders to identify the best course of action in complex and uncommon situations. Thus, by overlapping the process of constructive simulation with the stages of the decision-making process, the efficacy indicators needed for the analysis of the COAs and decision can be obtained [3]. Joint Conflict and Tactical Simulation (JCATS) is not a dedicated command-control platform, but can implement NATO reporting formats.

For the purpose of this paper, highlighting the role of constructive simulation in the decision-making process specific to airspace security management, we have built the matrix of concordances: operational requirements, missions and simulation platform capabilities (Fig. 1).

The main purpose of the WARGAMING execution is to validate the course of action, in which air force missions are established based on the Air Task Order (ATO) and Airspace Control Order (ACO). Thus, according to the operational requirements formulated by the air forces, the development, implementation and dissemination of these documents is the key element of constructive simulation training.

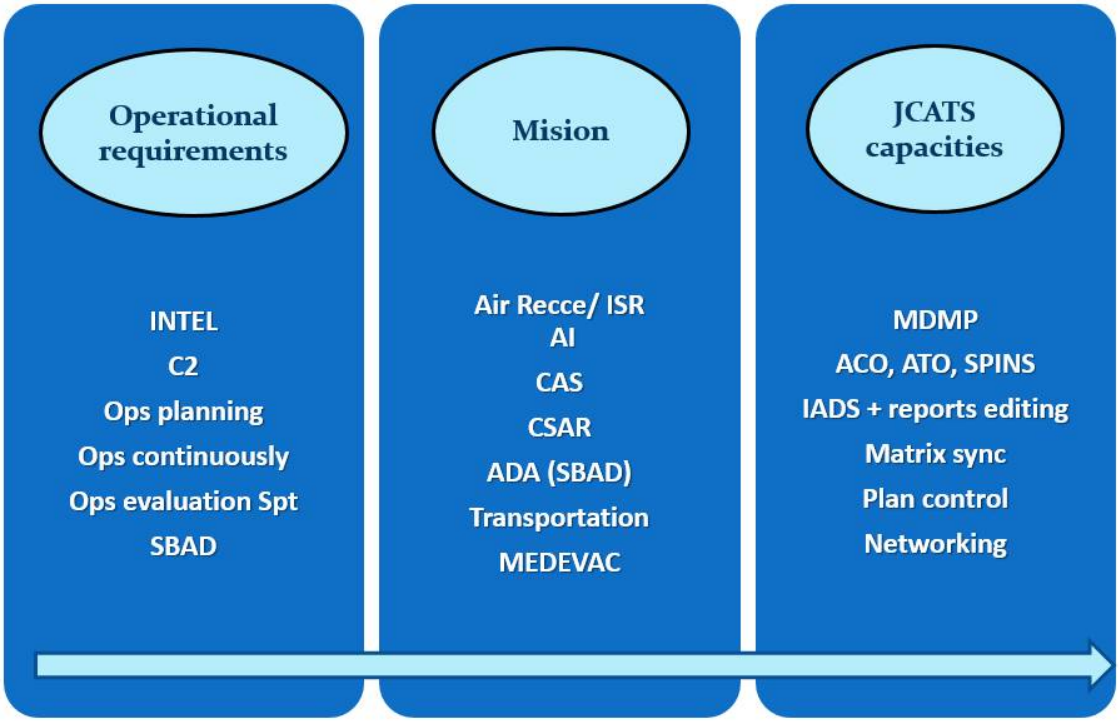

FIG. 1 The matrix of concordances

3. ATO, ACO AND IADS TOOLS

According to the air force doctrine, Air Tasking Order (**ATO**) and Airspace Control Order (**ACO**), combined with special instructions (**SPINS**), represents the main tool in planning, analyzing and conducted an air mission, provides tactical and operational direction for air operations.

An air operation is a complex and an integrated military activity, is conducted by air force and all structures which are link-up with air space security are implied: aviation (rotary and fixed wing), air defense artillery (ADA), unmanned aerial systems (UAS), surveillance and reconnaissance [5].

ATO and ACO are guidance to provide sufficient details to allow air components to plan conduct and execute a mission. They are a set of character-oriented message text formats used in support of C4 systems.

An ATO standard format contains some blank Intel witch have to be updated and we will show some of the [6], but a basic one:

- The mission **ID** represents an assigned number, a standard one, is unique and is used for reports and for publishing into the federation;

- The **Start Time** is the time when the systems will start to execute of any activity orders for the fixed or rotary wing;

This **Start Time** is one of the most important values because it must be and can be adjusted, using two standard controls: **Use start date of** and **Offset Time**.

- The **Mission Type** represents any kind of air mission, in according with air force doctrine; in that case all systems will have a different behavior, in according with the specifics of the mission;

In JCATS there are some standard missions like attack (ATK), capture (CAP), recon (RECCE) etc. and any type of mission can be selected from the standard or can be edited (changes type).

- **Tasked Unit**, **Depart From** and **Recover To** are a description of the aircrafts (group of aircraft). They represent the information obtained from the mission and the standard textbox can be filled with those values;

The mission can be edited from the standard window; on the left hand side is the Aircraft Groups, which contains the type of aircrafts that are needed (COMAO), aircraft **Callsign** and **IFF** settings (IFF settings can be sated in 6 different modes) (Fig. 2).

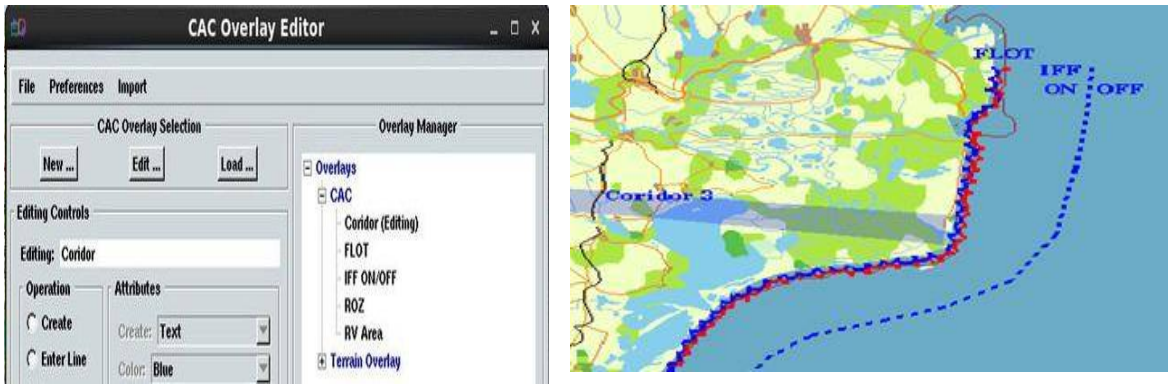

FIG. 2 Highlighting the IFF ON/OFF alignment with the CAC editor

In mission editing the **Description** textbox (location)has to be filled up, as well as the **Duration** of the mission, the **Altitude**, the **Route** (can be an activity like *Air Loop*), the **Specified Point** (the location of the order) and the **State** of the aircraft.

In ATOs we can add one group of aircrafts or more, and in this case the **Add** button has to be pressed to determine which aircraft to assign to the list and in which group. That means all aircrafts will have the same ATO and will follow the same rules.

Integrated Air Defense System (IADS) network consists in two primary tools [7]:

1. An Acquisition Radar, designated to detect incoming threats and hands off those acquisitions to the Fire Control Network;
2. A Fire Control Network which provides target tracking via a Tracking Radar and one or more platforms filling the role of the Shooter (Fig.3).

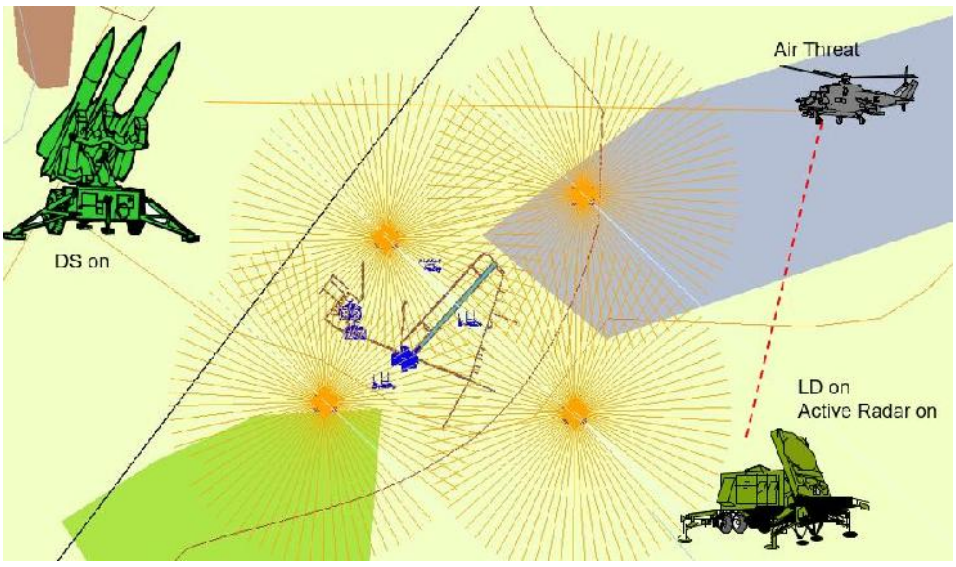

FIG. 3 The architecture of a combat formation

IADS can be built dynamically in the simulation. An example of a functioning IADS Network can consist of the following:

-IADS ACQ RADAR;

-IADS TRACKING RADAR;

-IADS SHOOTER.

In IADS the Acquisition Radar is not marked as ADA Tracking Only, it has at least one Weapon Station with an Active Radar. In a Fire Control Network there can be one or more IADS members filling.

The main role in Acquisition Radar is played by one IADS member, one system which acquires targets with his radar and provides those targets to the IADS Network; that means they can be handed off to the appropriate Fire Control Network for tracking and engagement.

IADS Network will automatically acquire incoming hostile aircraft and missiles and hand those tracks off to one of its Fire Control Networks for tracking and engagements. The IADS network will try to hand off an acquisition to the Fire Control Networks from the closest to the farthest from the target. The position of the Fire Control Network is taken to be the position of its Tracker.

There can be one or more Fire Control Network members filling the Shooter role in a Fire Control Network. The Shooter role is filled by a system that fires on a tracked target when commanded by the Fire Control Network. The Shooter has to be marked as capable of being fired in direct support mode.

The IADS Network manages two types of munitions guidance type:

1. Remote Guided – will always work but munitions may only be used in IADS. Remote guided munitions may be effected if the Tracking Radar is killed causing the munitions to lose guidance and the munitions will most likely miss the intended target.

2. Self-Guided – may be used but shooter and must have LOS (Line of Sight) to target, but acquisition is not required. Self-guided munitions are not affected by the loss of its Tracking Radar. If the Tracking Radar is killed while the munition is in flight, it will continue on to its intended target. Data requirement is that a self-guided munition must have a sensor defined for the fly out package.

Finally, a mission can be assigned to an IADS Network Acquisition Radar and the limits are on how the system engages on different threats based on mission priority. This feature is the same as assigning a mission to a system.

CONCLUSIONS

Training using constructive simulation using dedicated agent based simulation software (e.g. JCATS v.13), which meets the characteristics of air operations, represents a guarantee of the human factor value, both at the decision-making and execution level. The eternal concern for achieving interoperability on the organizational, procedural and technical level can thus be achieved by acquiring new competencies related to the efficiency of force structures, weapon systems in their endowment, or doctrinal regulations.

From the analysis of JCATS capabilities for Air Forces, it can be appreciated that the characteristics of aerial operations according to doctrinal regulations are respected as follows:

✓ *variety of operations* (execution of the air strikes from any direction; simultaneously on multiple targets; the transport of personnel and equipment in inaccessible areas to land or sea means);

✓ *mobility* (to achieve force protection in short and long distance due to the speed of movement);

✓ *continuity and reactivity* (the conduct of air operations throughout the joint operation; engaging and discouraging the Air Forces in a very short time);

✓ *coordination* (using airspace effectively with the possibility of applying airspace control degrees);

✓ *finality* (the Air Force operations aim to achieve strategic, operational and tactical objectives);

✓ *integrated used* (using ammunition of all types of forces);

✓ *combat intensity* (the possibility of calculating the sorties number/ fighter or the number of missions performed in a unit of time);

✓ *psychological effect* (displaying the scale of the air strikes and their effects on the target);

✓ *depth from the Forward Edge of Battle Area* (wide range of combat air systems).

The multilevel training requirements of the future air force officers include the entire package of modeling and simulation of military actions (Live-Virtual-Constructive) at the individual and tactical level.

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MOTIVATION OF PERSONNEL – ESSENTIAL PART OF LEADERSHIP IN THE MILITARY ORGANIZATION

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Abstract: *in order to achieve the predicted results, a successfully leader must start paying a special attention in motivating his people. This can be somehow difficult or even scary for some leaders because this thing means showing your emotions, public speaking, making yourself vulnerable. In spite of these difficulties, a leader must learn as many ways as possible to appreciate the effort and the value of the subordinate contribution in reaching desired results. This represents the essential part of motivation for high performance.*

Keywords: *leadership, motivation, recognizing others.*

1. INTRODUCTION

Leadership means influencing subordinates (individuals) - by providing purpose, direction and motivation, leading them to fulfill a mission (tasks) and improving the military organization[1].

Influencing is to make people do what you want them to do. It is the way or the method to reach two goals: leadership and improvement. Influencing means more than passing orders. The personal example is equally important both from the point of view of the actions taken but also from the point of view of the words you speak. Every action taken or word spoken by you in different circumstances will be an example, whether it will turn out to be a good or bad one. This is the most used way of using words and personal example for communicating purpose, direction, and motivation.

The key word here, to which reference will be made below, is the motivation. As a definition[2], it represents all the motives (conscious or not) that cause someone to perform a certain action or aim for certain purposes. In other words, it is the reason for action, something that gives the purpose and direction of a certain behavior, the greatest desire for something, the engine that makes things move in the desired direction.

2. MOTIVATION OF PERSONNEL

The motivation was, is and will still be one of the fundamental problems of psychology. In the same way, it is at the heart of the concerns of the practice of influencing people, whether it is leadership, education or psychological influence.

The issue of motivation starts from the empirical finding that any human behavior is directed from within, indifferent if it is action or thought, in other words, that the basis of human need is a set of moves that support the realization of human behavior.

The theoretical and practical preoccupation with motivation is supported by a constantly confirmed conclusion in practice: in any activity, a weak motivation of man leads to the use of 20-30% of his capacities, while a strong motivation leads to the use of 80-90 % of these capacities. Not properly motivating an individual involved in an activity is like using a low-skilled person for a job that requires complex skills by nature.

But what does it motivate? Money, power, fear, honor, status, success, revenge, prestige, hunger, pride, etc. These are just some of those elements that fuel motivation. If we relate to the source of the source that generates these elements, there are two forms of motivation: intrinsic and extrinsic.

Intrinsic motivation - denotes the motivative scheme that arises as a result of internal tension, pressure inside the individual, in the form of physiological or psychological deficiency (excess). (Ex: A person working on a project because he/she is interested in the subject, or attends theater and cinema shows because he/she enjoys it).

Extrinsic motivation - Defines the motivational scheme that arises as a result of a positive or negative pressure exerted on the individual from outside. (Ex: Promotion to a position considered to be advantageous from the point of view of income only from the point of being better paid, drafting a project to get a pass mark, practicing a sport to lose weight).

The key to motivation is that leaders need to connect the team's mission to individual long-term goals. The most effective leaders will try to motivate subordinates by reaching a consensus, by calling to common values, to subordinate sense of what is good and what needs to be done. The table below presents several ways, specific to the military environment, to use the factors presented in the motivation.

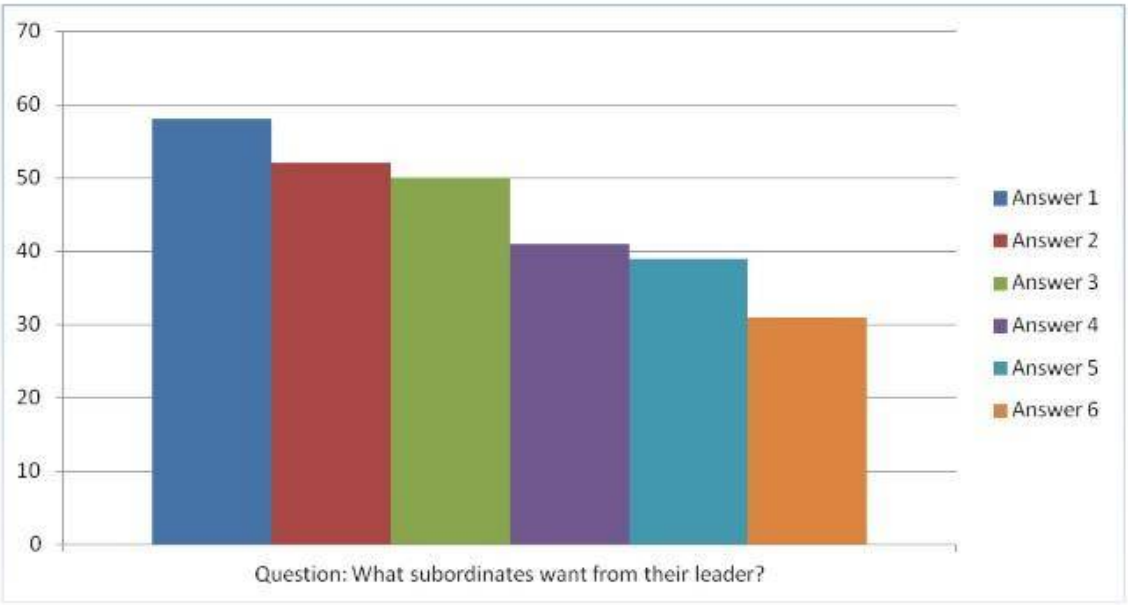
Table 1. Examples of ways to use the motivational factors

INTRINSIC FACTORS	EXTRINSIC FACTORS
• building a team spirit • allowing subordinates to make a difference or choose • support granted to the subordinate to achieve the personal goal	• awarding decorations • public congratulations or thanks • awarding distinctions and military insignia • promotion • thankful letters, merit certificate • the granting of defense and security weapons with engraved words, under the law • prizes in money or objects • appointment to occupy an important function

Let's look at things a little from the point of view of the subordinates. What do they want from their leaders? Following studies, we found the following views on what this question implies:

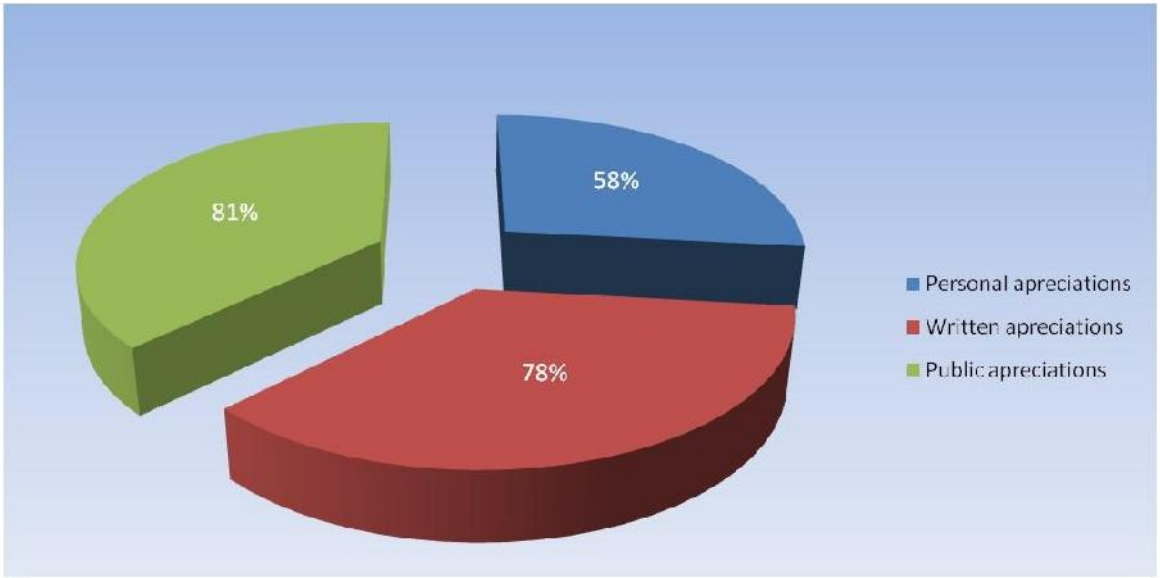
Answer 1: to use his time in a wiser way;
Answer 2: to have a well-run company;
Answer 3: to use their talents judicious;
Answer 4: to transmit only well-defined tasks;
Answer 5: to help me improve my career;
Answer 6: to thank me.

Table 2. Subordinate opinion on their leader



Another study on the periodicity of recognition of work accomplishments, with a target of 1,500 respondents, pointed out that very rarely, if not at all, they received appreciations in relation to the work carried out and the results obtained. A graphical representation of this survey is shown in Table 3.

Table 3. Nature of apreciation



58% of them appreciated that very rarely, if not at all, they received appreciations regarding the work done, 78% of the respondents received very rare or no written assessments and 81% said that very rarely, or not at all, have been publicly appreciated.

One of the conclusions that emerged from the analysis of the results gathered from the application of this study was that one of the reasons why some subordinates leave the workplace is the lack of recognition of the merits and the work done.

Developing a successful leadership is based on motivation, an aspect that proves to be taken into consideration as an essential skill, but which is also very difficult to master. In order to put into practice such leadership, seven essential things[3] are needed:

1. Establish clear standards
2. Establish a high level of expectations
3. Tracking the work of the subordinates
4. Personalized recognition of merits.
5. The story behind success.
6. Celebrating achievements.
7. Personal example.

The great leaders have always shown success in communicating what is really important. A set of common and easy to understand standards is vital to address in order to provide good motivation. This set of standards must be focused on achieving excellence and inspiration for staff.

It is necessary to include three aspects, and the first of these, in the path to credibility, is of value. Personal values are those for which a leader has to fight and organizational values are the ones he must impose. They must convey to subordinates the need for congruence between personal values and organizational values. If leaders want to be inspirational and aim at the total commitment of subordinates to the mission of the military organization, then they must make a concerted effort to understand the subordinates of their own values and how they are among the organizational ones.

The second aspect is clearly establishing the purpose. The goal is to provide a reason for action, channel the energy of members, and help to block disruptive factors. The existence of organizational goals is certainly better than their lack. One of the lessons for leaders is that they have to make sure their subordinates know that what they do is important and that they know what they use.

The third is feedback. The lack of feedback has been shown to have no result or effect on motivation[4]. Positive and personalized feedback is the most effective type of feedback (Ex: I saw what you did, I appreciate your work, that's why I think it's important, or here's how it makes me feel).

Leaders often get what they expected to get. High expectations are those that lead to high performance, and successful leaders should have such expectations, both from subordinates and from themselves. Leaders must first model their own expectations and then communicate them to their subordinates. Studies have shown that people are at first disturbed, even in difficulty, when directed to evolve to the maximum.

In the meantime, however, they, stimulated by the leaders' encouragement, develop confidence in their own forces and will rise to the desired expectations. Leadership participation thus confines itself to focusing on building a positive climate and recognizing the role they play in developing subordinate self-confidence.

The way in which leaders are interested in what subordinates are doing, the care for them is the way in which attention is given and the feelings to the beneficiaries mentioned above are transmitted. To follow the work of the subordinates can be done in two aspects with different finality: negative or positive.

When a leader constantly follows his subordinates to discover mistakes in what he is doing, he will create a distorted picture of reality, productivity will decrease over time, and his credibility will be reduced to zero. In a positive context, pursuing good aspects of subordinate work has more benefits.

Morality will first grow, contribute to the development of self-confidence, and create an environment conducive to double-minded communication where leaders will learn about issues and issues that concern subordinates.

To do this, however, leaders must focus their attention first and foremost on subordinates and their needs, to the detriment of personal attention.

Leaders must work in close proximity to subordinates. This is the way to create conditions for the development of working relationships based on sincerity and trust.

In order to be valued at maximum rates, merit recognition must be customized. Leaders must learn by their own means what are the subordinates' preferences. In order to achieve this, a wealth of resources, from the most varied, such as family, friends, colleagues, should be used. Account must also be taken of the fact that recognition of merit does not necessarily have to become a famous thing due to the consideration that some individuals prefer a more discreet profile.

One of the basic forms of communication is the story. This is the one that can have a stronger impact than the simple presentation of single facts or images. The story is the traditional method of conveying important lessons from one generation to another or from one culture to another. Stories are the ones that attach a human figure to success, those that create the models to follow, and make standards stand for life. Efficient story is an art that leaders need to learn and which they must develop to perfection.

The sixth essential thing to practice a successful leadership is to celebrate achievements. For an organization to be successful, it is necessary to develop a culture in this respect. The social events taking place on these occasions will be helpful in developing friendship and social relationships and will help in creating lasting ties that all subordinates will benefit from. It is proved that the leaders who organize this kind of activity will achieve a well-being of the subordinates, together with an increase in performance.

Great leaders will always be an example for subordinates. Leadership is the most exposed to criticism as a leader is always subject to attention. This aspect turns into a decisive factor when you want to convey credibility. Credibility is transformed, when it is shown by leaders, in strengthening team spirit, increasing the attachment of subordinates to the values of the organization by adapting and transforming personal values.

A mini-guide of the way a leader can motivate his subordinates, as presented by Hart and Waisman in *The Leadership Training Activity Book*, is presented as the end of this material[5].

1. Create an environment that is open, encouraging, fun;
2. Involve your employees in tasks that fit their experience and interests;
3. Respect their busy lives. Find out what they can manage to fit in, be flexible;
4. Give them work to do in small chunks and tasks that they can complete in a timely fashion;
5. Provide employees with clear instructions, a manual, and other pertinent information;
6. Involve subordinates in decision making;
7. Provide timely and specific feedback;
8. Give them your personal thanks, and do it often;
9. Plan recognition and rewards that fit the individual;
10. Celebrate their accomplishments.

3. CONCUSIONS

Based on the above arguments, in my opinion, leaders have to devote a significant amount of time to rethinking how to approach leading actions in the exercise of their duties through the development of essential skills for good and quality achievement of motivation of subordinates.

The desired goal, namely the accomplishment of the mission and the improvement of the military organization, is a desideratum that takes precedence over any other impediments that may interfere with the exercise of quality leadership.

For this, it is essential to build a favorable organizational climate by constructing a well-formed group in which team spirit and working together and identifying the demands of the workplace, the specific job requirements, so that the fluctuation of the resource human to reduce or even disappear. In other words, the leader must show confidence, respect and care for subordinates, and by displaying such behavior he will only be able to gather around him motivated people.

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THE PRINCIPLE OF COMMUNICATING VESSELS IN DISPLAYING THE EFFECTS OF TERROR

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Abstract: *This paper aims at analyzing the relationships between mass media and terrorist groups, based on the market logic. Apparently separated from visions, reasons, and systems of values, the two entities collaborate on this logic. The previous perspectives on this relationship, perceived as symbiosis or unstable balance between media and terrorism, are insufficient to provide a conclusive description of the relationship's dynamics. From the perspective of the* communicating vessels principle*, metaphor taken from hydrodynamics, media-terrorism relationships become meaningful and imply a distinct relational logic: the market logic. In this regard, we chose to illustrate the* principle of communicating vessels *by means of the case study on the terrorist attack on the Japanese subway of March 20, 1995.*

Keywords: *mass media, terrorism, symbiosis, unstable balance, principle of communicating vessels*

1. INTRODUCTION

Terrorism has existed since ancient times. Mass communication has been established at least 573 years ago, since the invention of the printing. There is a high level of interdependence between terrorist actions and their media coverage. Media and terrorism evolved constantly, converging sometimes, and always had a significant impact on the entire society. Taking into account the increase in magnitude of both entities' effects, of terrorist attacks on the one side and of media on the other, our paper aims to highlight the valves that provide the implementation of the 'principle of communicating vessels', in achieving the psychological impact on the general public. We illustrate this perspective through a case study that reflects the terrorist attack of March 20, 1995, that occurred at the Tokyo subway. In this respect, we used the assumption that, in order to produce effects on a global scale, there must be a sort of 'cooperation' between media and terrorism, even if this does not always happen peacefully. Often, this cooperation is not based on reciprocal trust, but on constraints and threats. To illustrate the case study – in a broader work which can be extended to a detailed analysis of the numerous terrorist attacks of the last decades – we used the documents analysis.

The paper has two centers of gravity: a theoretical one, more precisely a chapter in which we analyzed the connections between the effects of terrorist attack and those of mass media in amplifying the psychological impact on the public, respectively an applicative one, of emphasis of the theoretical foundations in a well known case of terrorist attack before September 11, 2001. In this regard, we used a transductive design, illustrating the connections between media and terrorism via some theories of physics, in their metaphorical light.

Later, we highlighted the role of media in promoting the terrorist organization messages and transmitting images from Tokyo subway. Through this paper we intend to highlight the complexity of the terrorist phenomenon, but also its natural connection with mass media, in the absence of which it could not exist. Media cannot avoid news with a high impact on the public, which, to the detriment of the civilian population, is provided by the terrorist act itself. The institutional symbiosis is placed, in the pages of our article, under the conceptual umbrella of the 'principle of communicating vessels'.

2. TERRORISM AND MASS MEDIA. FROM THE UNSTABLE BALANCE TO THE PRINCIPLE OF COMMUNICATING VESSELS

2.1 Conceptual delimitations. The international security environment is characterized by complexity, instability and continuous change. Current threats and confrontations encompass an extremely varied range of manifestations, within an environment characterized by the predominance of deterrence strategies faced to action strategies, and by military interventions for peace building and maintenance. Obviously, in such a climate of stability, the impact could be created by the asymmetric, acute and quasi-instantaneous actions and, of course, by their public coverage. In a previous work, we identified this form of 'moral asymmetry', which is based on disproportionate relation regarding the axiological systems, with the civilian population as the center of interest:

> Nowadays, the asymmetric actions have developed unbalanced possibilities of manifestations in relationship with democratic and humanitarian values and principles, such as the case of terrorist attacks. […] The first case of asymmetry in contemporary confrontations, that of terrorist attacks, brings to the forefront a disproportionate and unscrupulous action as a result of an axiological disproportionality. But this axiological disproportionality, judged in relationship with a system of beliefs and convictions close to the Western cultural space, can be understood in some cases as a false asymmetric action (Lesenciuc, 2016:19)

Until the 60s-70s of the last century, the philosophy of political realism was dominant; according to it, the concept of security is applied only at the states' level and it involves the protection of national interests against military threats. Even during the entire Cold War period (1945-1991), the threat to a state's security was defined from a military perspective and referred to the possibility of launching attacks between the military blocks or alliances in competition: NATO vs. Warsaw Treaty. Nowadays at the level of international security environment, there frequently appear non-state actors, that cannot be geographically located and that act according to their own norms, different from international or Western ones; an example in this respect is the case of the terrorist groups, such as Al-Qaeda and the Islamic State of Iraq and Syria (ISIS). As a consequence, the new major global threats are the terrorist attacks, the proliferation of weapons of mass destruction, the spread of epidemics, the climate change, and the mass migration.

Terrorism is not an element of novelty; it has been established at the moment of emergence of the first hierarchically structured communities. Over time, however, the terrorist actions have evolved and have changed their physiognomy according to the social, political, and technological characteristics of each periods. Terrorism benefits from a various range of definitions, all of them illustrating the complexity of the phenomenon, and the spectacular manifestation of violence, in order to produce terror and a huge psychological impact within broad masses of people.

In this context, the legal definitions are not lacking, and the Romanian legislation is no exception, see the Law no.535 of November 25, 2004 (updated November 22, 2016), on the prevention and deterrence of terrorism:

> [...] terrorism is the set of actions and/or threats posing public danger and affecting national security, displaying the following characteristics:
> - are committed intentionally by terrorist entities, motivated by extremist conceptions and attitudes, hostile to other entities, against whom they act by violent and/or destructive means;
> - aim at achieving specific political objectives; target human and/or material factors within public authorities and institutions, civilian population, or any other segment thereof;
> - produce situations with a strong psychological impact on population, aiming at drawing attention to the pursued goals (L535/2004, 2004/2016).

According to the field of action, terrorism has many forms of manifestation, such as: political, informational, media, economic, cultural, religious, cyber terrorism. Regardless the form of manifestation, there are some common features that enable the understanding of terrorism as a conflict characterized by 'moral asymmetry'. In any of these cases, yet, terrorism is the phenomenon set apart by "the lack of a defined theater of operations, namely by the expansion of the theater of operations at a worldwide scale; a various diversity of actions; the use of man as a weapon or as a mean of fighting; the lack of unitary strategic coordination" (Atanasiu & Stăncilă, 2014:15) [26]. In the collective opinion, the most well known form of terrorism is rooted in religious radicalism; this perspective have been considered valid before the radical change of the global perspective on terrorism, namely the event generically named '9/11':

> A true innovation at the end of the 20th century is represented by the emergence of radical religious groups (quasi-religions), that embrace terrorism as the main form of fighting. In some cases, these groups come from the main religions (Islam, Christianity, Judaism, Hinduism), but often there are sects with their own doctrines (Laqueur, 1999:80).

While traditional terrorism is manifested in order to fulfill political demands (gaining independence, expelling foreigners, imposing a new political or social order), the new terrorism (of the extremist religious groups) aims at destroying humanity as a punishment for the mistakes and crimes of humankind. The terrorist system of values is in opposition to the values of humanity, not only to those of West European or North American societies. The radicalization of actions, their understanding in the vicinity of the absolute violence and without discrimination is the subject of analysis in numerous studies; for example, the David Wright-Neville's Dictionary of Terrorism illustrates this dimension as follows:

> Religiously motivated terrorists are inspired to ignore the 'calculus of violence' whereby they calibrate their actions to be just enough to inspire and terrify but not to bring about universal opprobrium. Killing for God transcends this calculus, replacing it with a sense of messianic purpose with few earthly limits (Wright-Neville, 2010:36).

However, this is not just about religious fanaticism. Every terrorist is devoted to an ideology, transforms ideas into 'social levers' (Bell, 1960:370) [3]. Marginalized or ever rejected by society, terrorist reacts violently, adapting his 'props' to "a form of political theater wherein violence constitutes a carefully scripted performance designed to appeal to different audiences" (Wright-Neville, 2010:13). The terrorist violence present in the 'political theater' is not only a cause of damaging, but also of sending messages to intimidated people and to potential followers.

The terrorism is, from this perspective, a form of communication, the most violent possible, which can be achieved via only one instrument: mass media.

2.2 Mass media – terrorism interdependence. Principles taken from physics in understanding the market logic. Mass media is a composite term, coming from the words *mass* and *media* (from Latin, plural form of *medium* - mean). Mass media implies multiplying the message, by media as books, journals, radio, cinema and television, included in so called 'classical media' category. The term 'new media' has emerged in the context of the unprecedented technological development (mainly in the field of information technology), designating

> (…) those digital media that are interactive, incorporate two-way communication, and involve some form of computing as opposed to „old media" such as telephone, radio, and TV. (…) We have placed the term „new media" between quotation marks to signify that they are digital interactive media (Logan, 2010:5-6).

The relationship between media and terrorism has been analyzed by many researchers, especially since the 9/11 attack. Among those who have studied the phenomenon we mention: Wierviorka (1988), Rodrigo (1991), Garcin-Marrou (2005), Nacos (2007), Barnett & Reynolds (2009), Simons (2010), Freedman & Kishan Thussu (2012), Seethaler *et al.* (2013), Wiechert (2017), Marthoz (2017), etc. It is also worth noting the book edited by the Centre of Excellence Defense Against Terrorism, Ankara, Turkey, *The Media: The Terrorists' Battlefield* (2007), which includes, among others, the chapter 'Security of Media Personnel Whilst Reporting on Terrorism', written by the Romanian researcher Viorel Mihăilă.

In essence, the relationship media-terrorism is complex and involves mutual distrust and necessity. Anticipating the results of our study, this relationship is based on the market logic. While terrorism needs promotion (in its absence the attacks having no expected effects), media lives through audiences, based on the market logic. Considering media as means necessary for their public communication, terrorists force or convey them to transmit their ideologies and visions on the global scale. There are numerous instances in which terrorists spread fear among enemies, through campaigns of promoting violence. Media are always looking for spectacular events, and the coverage of terrorist attacks (cynically seeing) can be translated in terms of rating. Although after the terrorist attacks images and films of victims and disasters are circulated, the main goal of terrorists is not necessarily to cause great destruction, but to generate terror in the society, to determine many people to look at the effects of the attacks and to become aware of these. Despite the use of media coverage of these actions, many terrorist organizations also create their own media agencies, not based on democratic principles. Examples of these are Al-Qaeda's production house *The as-Sahab Foundation for Islamic Media Publication* or Aum Shinrikyo's *Aum Press* publishing house. In transmitting messages, terrorists use images, symbols, and statements that have a huge emotional impact on the public. Each terrorist organization has peculiarities not only in the manner of action, but also at the communicational level, of the slogans, in order to differentiate itself from others, to be easily recognized on a 'market of terror'.

Through the texts and images published, media posses the capability to influence public opinion. At the same time, they can create suspicion and create public distrust, such as in case of the 9/11 attacks on the United States symbols: the World Trade Center and the Pentagon.

These attacks, which had a significant international impact and launched the 'War on Terror' or the 'Global War on Terrorism', raised many questions regarding the American authorities' roles (see, for example, Michael Moore's documentary film *Fahrenheit 911* of 2004, which presents a critical view on Bush administration). The media influence was evident not only in reference to the 9/11 attacks. Media manipulation techniques to justify a war, an antidemocratic intervention, a genocide even, were frequently used; televisions used these techniques, some of them being extremely active even before the paradigm shift regarding the contemporary terrorist challenges. Televisions and new media benefit from the greatest interest for terrorist among mass media. Although the new agencies share written, audio and video information, the images have the greatest effect in terms of causing public emotions. Images can be received and interpreted despite the language and culture.

Another important aspect to be pointed is that terrorist organizations receive financial support through the agency of websites or social networks. For example, Al-Qaeda gained funds through non-governmental organizations and (so called) charitable foundations set up by its members, and some Chechen groups published their accounts online, for the direct financial support from supporters. The Internet, or the virtual environment, is the place where members of a terrorist group create and develop their relationships, including the relationships with members of other terrorist organizations. Ideas and information are communicated in real time on terrorist websites and on their virtual forums. Al-Qaeda even attempted to set up an online library and a discussion forum for the access of the new recruits.

Improving communication and global transmission of messages is not always beneficial to terrorist organizations. Media can cause

> blowback on terrorists and underline their appeal among key audiences, especially if the violence they penetrate is viewed as disproportionate to the cause for which they are fighting. As a form of political theater, terrorists cannot control the way in which audiences respond to the violence they commit as transmitted through the media. Focusing on innocent children killed by terrorist violence, for example, can lead to a backlash and shrinking of the size of the community for support (Wright-Neville, 2010:35).

Which are the conclusions regarding the so-called symbiotic relationship between media and terrorist organizations? Researchers are interested in this symbiosis between "publicity-seeking terrorists and drama-seeking media" (Weimann, 2012:188), quantifying the effects of terrorist actions through media coverage. The causal relationship media coverage – spreading of terror effects even led to understanding terrorist attacks as acts of communication via media (Rodrigo, 1991). Starting from this perspective, researchers have developed two interpretative models: of media culpable for the effects of terrorism, and of the media vulnerable to terrorist activities. Media are interested in drama, danger, violence, tension, in the terrorist spectacle within its extent, and the terrorist organizations are interested in promoting their messages and creating terror among people. The relationship between these two institutions pre-exists, regardless the interpretative model of media. Terrorism understood as communication via media brings to the forefront of analysis a certain form of understanding these mutual support relationships, undesirable by the media organizations, but necessary in the game on the global market. The reciprocal of 'Rodrigo's theorem' is understanding media as a weapon of terror, with a role in amplifying and multiplying the effects of terrorist attacks. However, the 'metaphor of symbiosis' is too tough, illustrating the voluntary cooperation for coexistence. It makes the relationship media – terrorism sliding to the interpretative model of culpable media. In response to this symbiotic design of relationships, the French

sociologist Michel Wierviorka (1988/2004:42-29) offers four possibilities of understanding the binomial relation media – terrorism. Wieviorka proposes a gradual range of possible dialogues between these two entities, beginning with the lack of any relationship; in this case, terrorists are just interested in promoting their own messages, without any certain form of dialogue with the media. There follows the indifference of the terrorists in relation with media and transmission of their message and of the effects of the attack. Then, there follows a terrorist pro-media strategy, rather based on media interest challenge than on explicit inter-entities dialogue. The last one is the transformation of journalists into victims of terror, and, implicitly, transformation of media in instruments of multiplying violence. The four instances describe gradually the dynamic relationship media – terrorism, possibly understood as unstable balance, i.e. balance maintained between the two entities only throughout the interval of maximum intensity, of the terrorist attack and its media coverage. Then, changing the position of one of the two entities, more precisely of media, by refocusing, by changing their perspective, they will move away from their equilibrium.

This metaphor is unsatisfactory too, because media naturally reach the balanced position for reasons that are different from those that determine the mechanical unstable balance media – terrorism. In addition, media change their perspective to remove the balanced position in relation with terrorist organizations is not the result of an accord with the terrorists. The change of perspective means, in fact, an assumption of their social position. Actually, different forces act on the two entities; they reach a random balance and return to the initial state of imbalance not reflecting the causes, but their own positions and reasons for such actions that have brought them to balance. An appropriate metaphor for understanding the relationships media – terrorism comes from hydrodynamics and consists of a description of the principle of communicating vessels or the principle of Blaise Pascal: in two connected recipients, the level of liquid is the same. In the case of terrorist attacks, their effect – the unstable and volatile liquid called 'sensational' – makes the connection between both entities, media and terrorist organization. This connection is done neither in a symbiotic way (in strict relationships with the reason to be of the two entities), nor as unstable balance (determined by the self-consciousness). A different logic feeds the two institutions: the market logic. Based on it, as long as terrorist organizations offer the raw material, the attack that has the minimal level of 'sensational' reached by the connecting line between the two recipients, media will cover it. Naturally, between the two recipients there is not exist a connection between the small quantities of liquid, in a so called hydrostatic balance. The terrorist attack is the exceptional case of the pressure exerted in a recipient, transferred to the second one, connected through the market pipeline with the first. The most eloquent examples in these terms are the quasi-simultaneous terrorist attacks from Charlie Hebdo in Paris, with 17 victims, and from Nigeria, produced by Boko Haram organization, with about 2.000 victims. The market logic has defeated the magnitude of the terrorist attack and amplified the most worthy of the cynical 'terror market'. The massacre in Nigeria has remained virtually uncovered by media, which in the logic of market means a major failure. The 'hydrostatic balance' of media – terrorists communicating vessels was modified only in the first case, due to the 'market of terror' interests.

To illustrate the functionality of this principle, we chose to study the case of a well-known terrorist action before the 9/11 moment, which does not involve the mental link with the Muslim religious terrorism: the Sarin gas attack on Tokyo subway (1995).

3. CASE STUDY: SARIN GAS ATTACK FROM THE JAPANESE SUBWAY

3.1 The attack. A special terrorist attack, done with the help of Sarin toxic gas, took place on March 20, 1995, at the subway in Tokyo, Japan. Sarin gas is one of the most dangerous toxic substances, because it paralyzes the central nervous system shortly after it is assimilated by the organism through mouth and skin. Following the spread of gas in six subway wagons on Marunouchi, Hibiya and Chiyoda lines, 12 people died and about 5,000 had circulatory and respiratory disorders. For the first time in the history of terrorism, an entire city was targeted. The terrorist attack, that was launched at 8:00, was very well organized: five teams of two individuals (an aggressor and a driver) attacked almost simultaneously the passengers. The terrorists, with their paralyzing gas packages wrapped in newspapers, entered the subway carriages in five different stations: Shinjuku, Ueno, Kitasenju, Neka-Meguro and Korakuen, few minutes before 8:00. All of them had umbrellas with sharp tips, in order to break the packs and cause the spread of gas. The three subway lines were not accidentally chosen. Marunouchi, Hibiya and Chiyoda converge in the middle of the governmental district Kasumigaseki, the area where many governmental agencies are placed. So, the terrorist attack was planned against the Japanese state itself. Although only a few minutes after the attacks the emergency management structures were called, their reaction was not effective from the beginning, because the causes of the disaster were unknown.

> At 11:00 o'clock the police announced in a press conference that Sarin was the source of the subway attacks. Up to that point the Tokyo Metropolitan Government, the Tokyo Police, Tokyo Metropolitan Fire department, the Japanese Self Defense Force (JDSF) as well as the Japanese national government did not have a clue what caused the effects (Van Mierlo, 2017:2).

The attacks of March 20, 1995, were completed by five members of the Aum cult. Aum Shinrikyo (in translation, *The Supreme Truth*) is an organization founded in 1984 by Shoko Asahara (his real name being Chizuo Matsumoto) and initially entitled Aum Shinsen no Kai (in translation, *The Supreme Beings*). The prefix 'AUM' is an acronym composed of the three Sanskrit words that describe the Asahara group philosophy: 'creation', 'conservation', and 'destruction' (Wright-Neville, 2010:99). Initially, the cult practiced yoga and meditation. In 1989, it gained the status of official religion for the Tokyo Metropolitan Government. The new status attracted over 50,000 followers until 1995, including Russia, Germany, Taiwan and the United States of America. Only young intellectuals were recruited, attracted by Asahara's speeches in universities. Over time, the group has become more and more isolated from the rest of people and more dangerous. The leader's will to change the society has intensified since the defeat in parliamentary elections in 1990. Since then, Asahara has carried out several illegal activities, including: the attempt to bring Ebola virus from Africa to Japan, the research and production of biological agents in Australia, and the murder of the lawyer Sakamoto, who launched allegations to the Aum group. The most important, however, is the Sarin gas attack which took place in June 27, 1994. However, although seven persons were killed and almost 200 injured, the attack was considered a simple accident. In the following year, the terrorist action were better organized and had a greater impact on the population. "The purpose of this attack was to set in motion social and political dynamics that Asahara believed would bring about his prophecy of the end of the world and the dawn of a new era" (Wright-Neville, 2010:100). Consequently, in the fall of 1995, the Japanese Government revoked the recognition of Aum as an official religion.

3.2 Media coverage. When a disaster occurs, there is need for a governmental strategy and an effective design of the intra-governmental dialogue, so that resource allocation can be facilitated and response plans can be effectively implemented. Also, communication between government and public is very important because it reduces panic among the population, supports eviction or quarantine, and provide instructions and information to victims and to other citizens. In Tokyo, at the moment of the Sarin attack on the subway, there was no communication and coordination between the structures involved in rescuing victims because of technical problems and of different ways of transmitting information. The communication also failed at international level, because the Japanese Government refused to report data on the subway disaster. Furthermore, public communication could not be achieved because of the lack of a specific strategy within the Public Relations Department. The first messages about the attack were directly transmitted via media and created confusion and chaos among citizens. The published images presented the way in which the state of the victims' health worsened rapidly, but without any information regarding the source of disaster. Shortly after the attacks, the news agencies focused on Aum sect and its followers, not on the biggest terrorist attack from Japan.

The Aum cult remained anonymous until 1989, when the Sunday Mainichi newspaper began to publish the interviews with six families, accusing Asahara of indoctrinating their children and integrating them into the sect. Consequently, Aum representatives reacted aggressively to the newspaper editor. They considered him overly overhead, and distributed booklets and flyers containing criticism to him. Gradually, other media structures became interested in the Aum activity and its leaders, who were invited to TV broadcasts to explain the organization's practices. In their opinion, no Aum's action was wrong; all who opposed them were considered culpable. Moreover, the Aum leaders denied in an offensive manner the accusations, thus obtaining the advantage and superiority faced to media. At the same time, in order to promote the cult's preoccupations, the leaders have set up their own press agency, Aum Press, whose editorial committee published the book *A Doom is Nearing the Land of The Rising Sun*, that included topics such as: Nostradamus prophecies, astrology, masonry, but also Aum members' vision that the world will end after World War Three and those who belong to the sect will be the only survivors (BBC NWA, 2016).

Being composed of intelligent young people, carefully selected, Aum organization was stronger than media, having the ability to influence them through determination, intelligence and clear expression of convictions. "Almost never were the interviewers sufficiently well-prepared with their own information so that they could effectively counter such a denial." (Hardacre, 1996). Media feared the followers of this religious cult. For example, although at the beginning of January 1995 the papers wrote about the existence of phosphatic compounds remnants in the village of Kamikuishiki (where Aum had its headquarters and where the police planed an inspection), the name of the sect was not associated with this discovery. In West, however, Andrew Marshall, the co-author of the book *The Cult at the End of the World: Incredible story of Aum* (1996), published an article on Asahara's knowledge of sarin gas.

Moreover, the way Japanese media have been manipulated by the Aum sect is highlighted by Tokyo Broadcasting System (TBS). After the lawyer Sakamoto disappeared, the representatives of this television were forced by Aum to give up the transmission of a interview with Sakamoto, in which he revealed details of certain evidence against the cult. After the subway attack in March, 1995, the Japanese media published Asahara's prophecies about the destruction of Japanese society, as well as lists with of members of the sect, most of them specialists in biochemistry and nuclear physics. Following the event in Tokyo, Aum group did not have any significant action, and its leaders were arrested and sentenced to death.

However, the group still exists, but it is divided into two subgroups: Aleph and Hikari no Wa, which are legally established in Japan and has also representatives in Europe. International press agencies such as: The Huffington Post, The Guardian and British Broadcasting Corporation, are still publishing articles relating the disaster, even if Aum has changed its ideology. All these press agencies are those that, each year on March 20, publish special articles about the Tokyo attack.

The principle of communicating vessels has perfectly worked in the case of Aum attack in Tokyo. Initially, the level of hydrostatic pressure was maintained at a low level. Then, the effects of the hydrodynamic pressure were amplified based on the market logic. Japanese media were, these days, the counterexample of how to act in such situations: they amplified without any explanation the effects of terror, did not wait for the official position of the government, and explored the spectacular side of the Aum organization, voluntarily maintained on the media analysis at a low pressure for five years.

4. CONCLUSIONS

The March 20, 1995 attack on the Tokyo subway, done by Aum Shinrikyo group is the largest terrorist attack in Japan, with a significant psychological impact, because Japan used to be a country with a very low crime rate. Moreover, although there are approximately 180,000 accepted religious groups in Japan, Aum was the first recognized religion by the Government associated with terrorist actions. In applying the principle of communicating vessels, media distorted reality based on the market logic. The press agencies have insisted on describing the target of terrorist attack, the district Kasumigaseki, the seat of many government structures. By analyzing the events produced before the attack, it can be seen that the action at the subway were produced to remove Police from Aum headquarters in Kamikuishiki, where chemical agents were deposited and where experiments were carried on. This aspect is also confirmed by the way of using sarin at the subway. First, the spread sarin was only 30% pure and was also in a form of less dangerous aggregation, namely in the liquid state. As a result, it is possible that the terrorist did not aim at total destruction, but merely wanted to demonstrate the Japanese government is vulnerable to the actions of the Aum cult. Another possible explanation of the attack may be the attempt of 'cleanse' society, or to draw attention to the closeness of the end of world (the supreme belief of this religious organization).

As stated during the work, terrorist organizations need media coverage, and the Aum cult is not an exception. Aum leaders were promoted, in terms of marketing, starting the period they were invited to the televisions shows. Moreover, they managed to coordinate and manipulate the press agencies in order to gain the benefits for the organization. The principle of communicating vessels in the media – terrorism relationship proved to be functional again.

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EGALITARISM AND THE CHANGE OF WOMEN's ROLE IN THE NATIONAL ARMIES

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Abstract: The feminist trend has influenced the way in which it is discussed and applied the principle of the equality among the genders. Nations are not at the same level in terms of diversity, integration or personnel policies and the egalitarian policies are slowly promoted into traditional societies. The international support policy of the role egalitarism is argueing it through the fact that we are all created the same way and not all the men are strong nor all the women are weak. The policy is supporting the necessity of unique standards in a way that the selection to be fair for both genders. The leadership and communication roles with the civilian population, especially with the women from traditional societies are encouraging asumming those roles, they are generating progress into negociation and are serving as examples for other women.

The aim of this article is to offer a detailed socio-cultural perspective over the women participation within the national military forces. The economic changes, the way in which the legislation and the national cultures are determining changes in the women's role, had generated effects in their attitude towards they are treated by the society. The financial independence has offered them trust inthe choice possibilities and the wish to extend their roles in different national armies.

Until recently it was well spread the bias that the „War" is exclusively men's domain. The presence of women in different wars is not new, from the Russian women fighting batallions (mentioned in the First World War documents), to the light cavalry units, the first aid, medical care, signal or logistic units and office activities. Traditionally, women's role in the society was very clear defined and that is reproduction, sensibility and the care for the family. This seems to be in antagonism with the integration and the trust of the group and is creating the idea that introducing women in the fighting groups is atracting a group cohesion breaking. The evolution of the way the social role of the women is perceived from the victims of the conflicts, the persons that are taking care of the disabled persons towards equal members of the society that are participating into all the aspects of the social life, is politically supported at the international level. This is the new „egalitarism model" promoted and supported internationally at the political and the financial levels. The feminist trend has influenced the way in which it is discussed and applied the principle of the equality among the genders.

The reservation into women'sadmittance into close combat and within the Special Forces is routed in traditional societies in which the social, religious, and cultural factors are restricting women's rights and offer them special roles. Those factors are are put into serious doubt by the developed societies. For example, a study of the Canadian Institute for Military Leadership related to the operational efficiency of the mixed combat groups has demonstrated that the gender diversity is not affecting the operational efficiency [1].

Since 1961, female officers have organized conferences and meetings whose topics were aiming to discuss the women's rights and status in NATO armies, the working conditions, the possibilities to advance into the carrier, etc. In 1976, NATO Committee on Gender Perspectivewas recognized by NATO Military Committee [2].

The problem of women's integration into the defence sector is on UN Agenda and it has beed endorsed through a UN Security Council Resolution No 1325. A study about global implementation of this resolution has shown the progress into positive women's integration effort into defence and security sectors and also the positive effect of this implication [3]. In June 2017 have been adopted eight UN Security Council Resolutions number 1325, 1820, 1888, 1889, 1960, 2106, 2122 and 2242. These are recognizing the existence of differences in between the genders and the repercussions of those particularities in the armed conflicts and they are proposing female protective measures and their role into the armed conflicts [5].

NATO member countries have developed national policies related and in accordance with the international ones that ensure women's support from the National Armies and are guaranteeing equal rights with men, but are still existing problems in accepting in some systems the policy of the equality in between the genders.National Action Plan is representing the legal engagement of the states related to the implementation of the UNSCR1325. Ome of the immediate effects of the implementation of the Plan at the national level were as follows:the increase of the womenadmitted into the Armed Forces, studies concerning the needs for infrastructure generated by this admittance, the introduction of common training courses in sensitive aspects generated by the women's presence into the Armed Forces, the adoption of new personnel policiesand specific behavior codes, the revision of the military educational curricula of the educational facilities, etc.

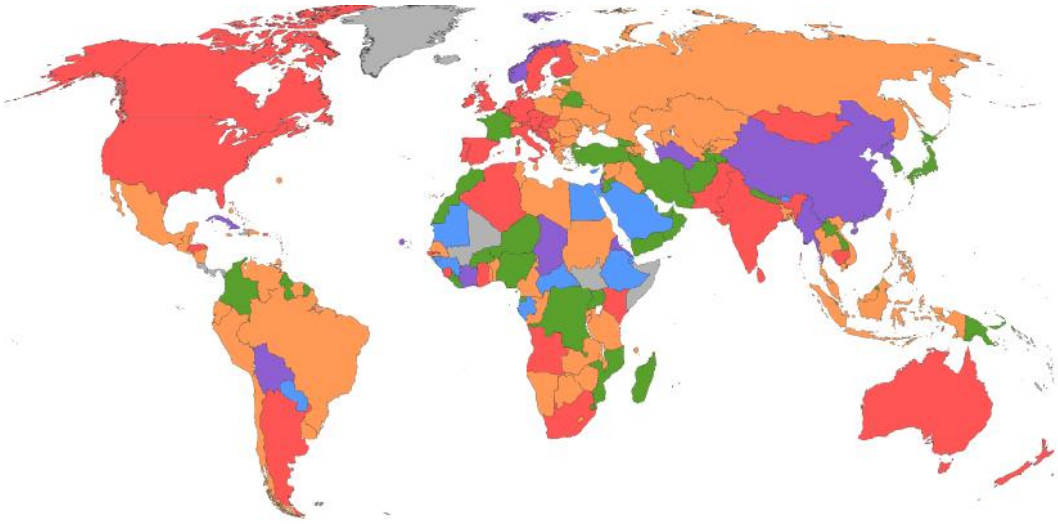
In 1995 Segal has launced a teoretical model in which he had identified three components (military, social structure and the cuture),that have a direct link with the modifications of the women'role into the Society and into the Army. *"Women are integrated and have a high level of participation into the states being in deficit of labour force (because of the decrease in demographic and economic factors) and where the State policies are supporting the social equality and the cultural value [5].*

In 2002, Iskra et al. are extending Segal's model adding factors such as domestic policy and the institutional ones. They are supporting the idea that the states that are governed by civilian leaders, having a liberal political leadership, that are promoting egalitarian policies and they are supporting non-violent political changes, are creating the conditions for the equal participation of women in the Army.

The active participation of women in all economic branches mainly technical ones, on which is added the support for International Movement for Equal Rights are generating a strong movement for the equal participation of women in all military roles.It is not wrong to assume that the active presence of women into civilian technical branches has generated the opportunity that those to to function very well even into those reserved previously only for men.

There are significant differences in the way to approach the women's role in the World Armies promoted by the feminist liberalism in contrast with the radical one. As a result of the experience accumulated in the theatre of operations from Afghanistan I can say that the wish of the majority of the female military belonging to NATO armies is not to be seen as equal in all physical capacity and abilities as the men, but to be able to have equal opportunities to to apply for the same positions, an observation that supports the liberalist model of the equality among the genders.

The following image is the representation of the women participation in the Army all over the World.



Agenda: **Blue**: Women are not admitted into the National Army.**Brown**: Women are admitted into the Army;**Green**: Women are accepted into the Army but are not treated equally; **Red**: Women are accepted into the Army and are treated equally; **Pink**: Mandatory military service; **Grey**: Uncertain data [6].

Eight states have mandatory military service for women:Sweeden, China, North Koreea, Norway, Israel, Ciad and Cape Green [7]. In the same time with the change of the international policies related to the mandatory military service, it appeared the issue of unsufficient volunteers, opening the opportunity for women to apply for certain branches that were restricted before.In 2013 the majority of NATO countries were offering equal opportunities for joining the Army both women and men, in comparison with the year 2000, when only six NATO states were offering the same.

There is not the same level of national politics related to the women's presence in the Army or in combat units.Some politics are excluding them for different reasons, starting from the physical differences in comparison with the men and continuing with those reffering to providing a special environment, private for them.The active aspects of the argue at the international level on the subject of the equality of genders inside the Army are as follows "is it timely the acceptance of the women in combat role, body to body?Are they prepared physically and are having the natural psychological capacities to be equal members of the close combat fighting units?"

In 2014, close combat was described as "an intense activity, visceral, unavoidable, where violent death, wounds, terrible noise, the blood and a high level of emotions are common aspects [8]. This description is raising question marks if close combat is representing an environment in which women can properly function, without affecting the efficiency of the team to wich they are belonging to.

Most of the researches related to women's presence in specific military branches that were used previously by men, were done in USA and United Kingdom. Ther have been observed and monitorized females functioning in mixed groups, joining them as volunteer for this research programme, with or without previous military experience.The initial concern of the observers group was related to the negative effects over the physical and psychological health of the subjects, both on short and long terms, on which were added possible effects resulting from the intermingle of women with men that are generated over the operational efficiency.

Some specific positions are involving movement on long distances with heavy mandatory equipment, women having a light muscular and bone structure, a smaller hearth the men and a muscular mass reduced with 30% and a wide pelvic scheleton [9].

The research carried out in between 2002 and 2010in United Kingdom analized the effects over women's presence over the mixed groups cohesion and operational efficienty. The results of this research had generated the decision not to accept women in the fighting units that involve close combat. It is a decision that is revised evry eight years.

Inside US Marine Corps it was carried out a nine months research which has been finalized in a study which has more then a thousand pages. It reflects the way in which the inclusion of women into marine fighting groups is affecting their efficiency.Some results of this study are reffering to: the number of women that had suffered injuries, especially muscular and bones ones, is twice higher the those of men, the way in which women are handling the weapons is not precise, they are having a reduced capability to evacuate the injured persons, the movement of units are slowed down, the equipment used have to be adjusted for women to fit the anatomy of their body in order to be able to use properly the weapons and to move on long distances, the effort resistance is reduced, etc.

Anoyher research over the opportunity of the acceptance of women in different roles was done during the training courses for US Rangers. The volunteer participation in finding women's skills for this type of trining was a tremnduos failure. From 30 women selected from the volunteer group only three have reached the final stages of the course without completing it. The last two that get to the final stage were offered the chance to graduate the course. It has to be mentioned thatboth finalists of the course are former professional sport women, with a large military experience.

Women's presence in the theatre of operations from Iraq and Afghanistan had accelerated the political discussions to support equal participation of them in all the combat roles. In the same time there was a high accumulation of data that are not in this support framework. A significant example related to the negative aspects of women functioning in mainly men's roles is that of CaptainKatie Petronio, US Army. Despite an execellent physical condition, of a long time spent on active duty and a veteran of the Iraq and Afghan wars, after ending the missions, Petronio admitted that the excessive loss in weight and irreversible health problems gained are reasons to declare that women are suffering accelerated physical disturbancesin comparison with men and the inclusion of women in combat role will represent a huge increase of medical costs of the nations [9].

The results of the military studies are supporting the fact that military females can bring an added operational value from different perspectivesin the decision process, different communication and analysis skills in specific communication styles with the local population from the traditional societies [10], but the recent researches are showing that for for specific roles women do not fulfill minimum physical and psychological standards.

Seventeen countries had adopted the decision to allow women to take part into combat role: snipers, Special Forces, etc. Rhese are Belgium (2010), Canada (1989), Denmark (1988), Eritreea (2013), Finland (1994), France (1985), Germany (2001), Israel (2004), Lithuania (2000), Estonia (2013), Nederland (1979), New Zeeland (2001), North Koreea (1950s), Norway (1985), Poland (2004), Romania (2002) and Sweeden (1989).

In 2000 it was adopted an amendum for equal chances in military service that is guaranteeing equal opportunities for women that are proving physical, psychological ans personality qualities to apply for such positions.

There were established mixed platoons within the infantry and artillery units and some of the women got to be pilots even the percentage of them into the professional army are reduced. After 2011, the majority of the participating armies to the multinational coalition decided to give up the restrictions for the women's appointment into combat roles. As a consequence of this decision there was am increase of the attention in the personal policies.There was also clearly stipulated that on long term this decision can have a negative impact over the tactical capability of the groups if the standards for physical tests are not accomplished, but the reality was different. In 2013 when they gave up gradually the restrictions for women participating into combat roles and in December 2015, US Secretary of Defence, Ash Carter, announced that all the roles that previously were reserved for men will be opened also for women [12].

The results in women's testing that wanted to fulfil such roles in the UK Ministry of Defence, in 2014 showed that only 4,5 % are accomplishing the recruitment standards for such positions [9].

Women's inclusion into combatant troops determined a possible risk that generated a carefull attention of the politicians and human resources managers. The sexual harassment issues that is brought on the agenda nowand the punish related to this are now clearly defined in the moment when women decided to accept the combat role.

In Afghanistan, civilian and military women from the coalition have proved that they have an important role and the gender is representing a cultural advantage increasing the efficiency of the capabilities. The advantage of using women in relation to the civilian population made that the definition of "responsibilities related to work within the theatre of operations" for women to be modified. They proved that they can adapt also to the training programmes that were previously and traditionally designed for men. It is true that those programme in order to be efficient they must have a longer period of time that the one allocated for mens' physical training [14].In Afghanistan theatre of operations women participating in combat missions have to accomplish both specific tasks and those related to the security of the group. Military females and civilians from the Coalition Forces had operated in high risk zones in mixed teams. Functioning inside FET (Female Engagement Team) meant a great benefit for the coalition, determining the relationship in between those and the Afghan women. These are representing nearly half of the population, very useful sources of information, icreasing the strategic and tactical operational capacity. In different armies (for example Canadian Army) was registered at the beginning a reduction into the cohesion of the mixed units but, with a pro-active leadersip, the transition has represented a success [15].

Armies are traditionally conservative entities that are responding rapidly to such changes. How small combat units can be affected by women's admittance inside them? This question is drawing our attention to this: how the trust is working, related to the cohesion and the sexuality inside the multinational coalition, especially in small units like Special Forces. The indicator "*Hiper-masculinity*" has a central role in military sub-culture because is related to the cohesion and motivation. Physical test are the first barrier in the selection process and for women's integration into combat units. The impossibility to maintain this effort level is perceived by the other members of the group as being poverty, a dilution of the capabilities.A British study concerning this element inside different armies, a research done in 2010, has established that in countries where this option exists only approximately 1% of women can apply for positions in combat units aftewr they accomplished the physical test.

Studies related to women's integration in different armies concluded that it was a possibility that this integration to have a negative impact over the cohesion of the groups. In the year 2010, starting with the revision of the policy concerning women's appointment into British combat units, there was a recommendation to stop this because there was "*a potential risk associated with the maintaining of the chohesion into the mixed tactical groups engaged into intense close combat*"[13]. The risks are coming from different directions: disruptive relations, competition of men to get the attention of the women, and "*flirtul*" to which the women are keen to resort into an environment predominantly with men. All those elements are determining a reduction of the cohesion [18].Despite all of these, the reality had proven that well thought personnel policies can brig a harmonization of the contribution of the genders to the operational process.

It has been observed an increase of the female number within the multinational contingents. In the „Resolute Support Mission HQs", ther is a separation of genders in terms of accommodation facilities because the participating nations can interpret in an offensive way the equal treatment of men and women, but in KAIA multinational base, mixed accommodation did not created problems from the behavioral or moral points of view.

Into the Coalition where we have contingents from traditional societies such as Afghanistanand Pakistan it is difficult for those to accept orders from female military, being an offense and an attack to their status. Also the military that are accepting orders from females are losing their respect in front of their soldiers. The same discrimination is happening in social activities carried out by traditional countries where females are never invited. This sum of consequences is generating frustration among women coming from democratic societies and they hardly understand this social unjustice that can generate diplomatic conflicts or aggressive direct reactions.

When into a united group it is introduced a potential sexual partner, female or male, this can generate malfunctions into the social dynamics of the group. A person that is "*different*" he or she changes "*the rules of the game*". Hiper masculinity is associated with the fighting efficiency and the cohesion of a group.As long as the performance achied by the group is higher, the higher the reputation and the respect are. Women introduction into combat teams together with the introduction of the legal provisions concerning sexual harrassment can bring different interpretation of the men's behavior as being misogynist. In relation to the men is up side down interpreting this as an attempt to bring female features to the group generating frustration hate and disappointment with respect to females belonging to the group.

As a result of what I presented, the logical conclusion is that the simpliest hope for the small combat units is not to have the sexual relations inside those teams and belonging to different gender group or sexual orientation one to be considered „asexual".

Another aspect generated by women's presence ito military bases is the high level of attention they are getting. If the sex can be agreedthere are two additional aspects, first because men are jealous and consider that is "unfair" in connection with the others and secondly that women are always "privileged". Group leaders have to show determination and rightness in order that their actions not to be interpreted by the other members of the group as representing protection or condescendent behaviour. Generals Petraeus and Sinclair are the most recent examples for risking their carrier in return for some relations considered by the Ammericanpersonnel policies as being nonprincipled.

The International Organization pre-ocuppation related to the Afghan female rights was materialized in programs to incorporate a certain number of women into the Afghan Army and Police.

But even it has been allocated more that five thousand of posts for women into the structures of the Army and of the Police and they had finished the specific training, the posts allocated for women are still continuing to be ocupate by men.There have been created scholarships for studies especially for women, special places for basic military training in different locations inside or outside Afghanistan. It is taken into consideration also the cultural factor, the traditions, the role and the acceptance of the family members in all those stages.The Afghan female that graduated ANAOA (Afghan Officers National Defence Accademy) are involved into the female recruiting process that graduated high schools or universities, in accordance with the ethnic representation and the tribes from where they are coming from. Because of the traditional society and of the religious extremism, the option to be part of the Armed or Security Forces is exposing the female to major problems; they can be even being killed because of the "shamefull position" in which they can be during this period. This is why the use of the uniform and of the weapon is not allowed outside the normal duty.

The determination of the Public Opinion in the effort to support the equal rights for the female military in connection to the military menhas been proved again when CorporalJacinta Baker died in Afghanistan. New Zeeland Prime-minister has publicly declared that his country will not accelerate the withdrawal of its troops and will not initiate a re-evaluation processof the womwn's presence into the combat missions [19].

The geneal trend is that women to be admitted into combat related role that in the Past were related to men. This change brought multiple benefits into the Theatre of Operations from Afghanistan especially in terms of increasing the efficiency of the capabilities. The question is the on long term the public opinion and the arms counterparts will accept the loss of the female military in combat with the same emotional implication as for a man or comrade.

CONCLUSION

The historical evolution has proven that women can fulfill diverse roles including the leading and the fighting ones. The recent experience from the theatre of operations from Iraq and Afghanistan has shown that women are very good planners, analistsand fighters, with precious communication skills, in those traditional environments. There not yet many examples to confirm or deny the way in which the efficiency of the fighting groups has been affected by the women's presence into the thatre of operations or in close combat, because ther have not beed carried out research related to this aspects.

Nations are not at the same level in terms of diversity, integration or personnel policies. It is important tha tose personnel policies to show that "lessons learnt of the developed armies", concerning the gender equality are transmitted to those less developed armies.

Assigning equal roles for the women in connection to the men into the combatant forces is a very sensitive aspectfor some states. Now a growing number of women are occupying positions within the World's Armies wishing to benefit from the economic and labour opportunities offered by the Army. Even there do still exist in many traditional the social division of labour and roles, the equal access to education followed by economic independence, have generated freedom of choice and participation. The egalitarian policies are slowly promoted into traditional societies, existing some signs of change.

The socio-cultural evolution is generating changes in the perception way of different aspects related to the social role changing. We are seeing more female leaders, managers, commanders, but we are also seeing men in "household" role. Unfortunatelly military environment is a conservative one and the significant roles are still reserved for the men.

The weak representation of the women into the decision process is reflecting over the personal policies.

The international support policy of the role egalitarism is argueing the support through the fact that we are all created the same way and not all the men are strong nor all the women are weak. The main point of this policy is supporting the necessity of unoque standards in a way that the selection to be fair for both genders.

The differences related to women's role into the Armed Forces still exist and probably will never ever be leveled because societies and the armies are evoluting individualy being in present far away one from another and the stagnation process of some of them is hardly possible to happen. There are general rules regarding women's role and the rights in the modern armies, but the national differences will be always there, especially manifesting their influence inside the coalitions. The leadership and communication roles with the civilian population, especially with the women from traditional societies are encouraging asumming those roles, are generating progress into the negociation and are serving as examples for other women.

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SEXUAL HARASSMENT – PRECAUTIONS IN THE MULTICULTURAL INTERRELATIONSHIP WITHIN THEATRE OF OPERATIONS FROM AFGHANISTAN
"With power comes responsibility"

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Abstract: Sexual harassment and the impact on the victim is part of the understanding the military culture, the responsibilities of the chain of command, the rights of the victims and the respect of the standard procedures in a multicultural environment, specific for a coalition operation. The article analyses the main causes of sexual harassment from working in mixed teams in hostile conditions, to alcohol abuse, stress and limitations imposed, to a leadership that is not prepared to recognize cultural differences, or to impose group barriers. It also takes into consideration the interaction from multicultural point of view like visual contact, minimum distance accepted, the way to address, gestures, comments, gossip all of them determining the victim to live with the shame to be judged and blamed, suffering restrictions in training and in taking part into missions, or affecting their carrier.

1. INTRODUCTION

Multiculturalism, cultural differences, differences in organizational and personnel policies generate frictions of varying degrees within multinational military coalitions. The way in which militaries of different armies perceive interaction varies from one society to another. Different forms of sexual assault are perceived and treated differently by the military of different nations, given the differences between national cultures and national laws.

The issue of sexual assault is actively addressed by states and armies participating in the multinational coalition, but national law and how to prepare staff for missions is different from army to army. Advanced armies pay special attention to the aspect of sexual assault. International, national policies, activation in multicultural coalitions are factors that have contributed to the increasing importance of this issue. Any form of sexual assault is against the law and policies of military organizations. The desire to manifest power weakens human spirit and can generate physical and / or emotional abuses, with various types of sexual assault, stereotypes, marginalization, etc. Forms of sexual assault are very diverse, ranging from verbal content with sexual connotations, contact and / or physical aggression to visual and auditory media, etc.

Existing elements in society also find correspondence in the army because it is a reflection of society. The military environment is predominantly male, "a world of men," a reflection of the social system to which the military subculture belongs. The international feminist current imposed changes in attitudes and rights granted to women. Moving from the "world of men" to a common world, where individuals have equal rights and obligations, is not suddenly done, but it is still necessary for a period when rules must be taught or imposed if the common sense does not work. Until recently, operational positions were occupied by men, women occupying administrative,

medical, technical posts. While preserving the social model, men were taught to "accept" women only in these roles, that is, the stage of social evolution.

2. SEXUAL HARASSMENT IN MILITARY ORGANISATION

Current generations are the product of the struggle to achieve equal rights for women, who know that there are laws and institutions designed to protect these rights. In the fight against sexual abuses, various attitudes adopted by military women in their careers have been recorded, attitudes generated by how they perceived they are helped by legislation and support bodies created in their support. At the beginning of this struggle, women were just victims of the war for treatment and equal rights. As the established institutions began to enforce the laws and procedures, the persecutors received their punishments, and the publicity that was made on the subject clearly translated the message of equal treatment of the sexes.

Sexual abuses do not just happen between women and men. Men can also be assaulted by their organization colleagues. The military environment is a particular one, in which during the training and functioning in common spaces and sustained stress conditions, negative character traits can be activated. The slogan "boys are boys" has created the opening for accepting jokes in boys' groups but these jokes brought to the extreme generate feelings of demasculination, reduction of personal dignity, respect and confidence within the group. Abuses are generally caused by those of higher rank than the victim, with the primary purpose of showing them who owns the power. Generally, aggressive actions escalate in amplitude as they evolve.

Various forms of sexual assault have been manifested and continue to manifest in modern armies. Two notions are often spoken on this topic: sexual assault and sexual abuse. These include unwanted treatments and/ or undesirable advances, of sexual nature culminating in non-consensual sexual relationships.

The reports have found that one of the main causes of unwanted sexual behaviors is alcohol consumption. Another favorable cause is the stress and limitations imposed by the operating space in theaters of operations. Another favorable case is unprepared leadership in recognizing cultural differences and imposing barriers in the group.

The annual reports drawn up by different armies have as common denominators the following causes for which victims choose not to report the different types of wrong sexual conduct: breach in the confidentiality of the process, shame, fear of being "condemned and judged" by colleagues, fear of unmerited disciplinary consequences, restrictions from the preparation and participation in missions, affecting the level of the Security Certificate, fear of re-victimization, etc.

Military organizations respect national laws but also apply their own culture with specific norms, practices and customs. The key to understanding the military culture and the impact that sexual aggression has on the victim lies in knowing the responsibilities of the chain of command, the rights of the victim, and the observance of procedures, which in the advanced states are very clearly stated. Without all these conditions being met, the punishment of the guilty cannot be achieved and the victim is the one that suffers emotional trauma, career pressures and social blame. For example, it is up to the commander to determine whether a case has to follow the legal course, who is part of the investigative team, etc. which allows the subjective approach of the whole process and raises the question of conflict of interest and / or abuse of power.

In some cases, the commander is not sure of the type of aggression, making confusion between indecent, physical or verbal behavior, directed against another person, sexual assault, sexual abuse, sexual harassment.

Lack of adequate training on this line generates decisions and courses of action which, for future research, are impediments to the research process and influencing its verdict.

Aggression, abuse, sexual harassment in all its forms affects the effectiveness of military missions. The military environment presents particularities generated by the preconception that "it is the world of men". Unfortunately, there are still cases in army interaction where women who are victims of sexual assault are accused of creating conditions favoring deviant behaviors in prolonged stress situations. Information protection deficiencies in staff training (reporting chain, time, responsibilities), continuation of activity in the same environment as the aggressor (often in a subordination position) to which the suspicion of co-culpability by provocation is often added, collectively projected on the victim, are elements that make it harder to investigate guilt, favor perpetuation of sexual aggression, and emotionally traumatizing victims. There have been countless cases where both victims and potential witnesses of various forms of aggression have suffered the group's revenge. All this is a powerful reason why many of the victims chose to silence the event.

In the US Navy, for example, the investigation begins when the victim's complaint is officially registered. From that moment on, the whole life of the aggressor becomes the subject of research, the organs accredited in the research have automatic access to the computer, to the personal and service telephone, can carry out inspection in the area where he lives, etc. and final punishment and stigma within the Military Body are relentless.

3. ASPECTS OF INTERACTION IN MULTICULTURAL CONTEXT

Unwanted sexual advances, preferential positions in staff schemes, disciplinary measures conditioned by accepting or not accepting these advances are just some of the issues in which women have their career and emotional status affected. When people with a higher rank thank the one of the victim claim sexual favors in return for benefits or advances in rank, it is a crime. Another form of sexual assault is represented by the hostile conditions at which staff are exposed to cause sexual concessions. There have been countless cases, even in the Afghanistan theater of operations, related to exposure to operational situations, subject to sexual favors. Persistent gazes, languros, flirting, comments about a person's sexual orientation, gestures and comments about specific physical traits, jokes related to pregnancy, unsolicited massage, embellishment, gossip, use of offensive diminutives, display of posters with sexually content, sending emails with masked or sexually explicit content, accessing sexual content from the computer, role comments, etc. can be interpreted as sexual assault if they are not wanted.

I will present some of the aspects of interaction in multicultural perspective and of different perceptions of sexual assault issues in the Afghanistan theater of operations.

Visual contact - for European countries, maintaining a visual contact during the conversation is a sign of attention and respect for the participants in the conversation. Similarly, greeting is accompanied by brief exchange glances. Italians, French, Romanians, etc. can accompany the greeting with a smile without any sexual connotation but just as a sign of politeness. The reaction of militants, especially women, from the coalition is a misinterpretation of this non-verbal language, amid an aggressive anti-aggression policy and a sustained premeditated preparation.

There were also complaints of US female staff against Afghans working alongside the coalition in the sense that they were too insistent.

In our opinion, most of these situations are only the result of curiosity, knowing that women in uniform or civilian feminine staff are a curiosity for Afghans resulting from a different way of perceiving the role of women in society.

Minimal accepted distance-represents another important cultural aspect that can be interpreted differently depending on the culture from which the military comes from. It is very interesting, for example, the observation made during informal meetings during which a true "dance" of interactions takes place.

Militants belonging to states where the accepted distance is more than one and a half meters (USA, UK, Northwest Europeans) feel "invaded", "suffocated" by the conversational partners coming from states (Italy, Greece, Afghanistan) whose minimum accepted distance in interaction is less than one meter. The minimal distance, accompanied by touch gestures, triggered obvious retaliatory reactions among the military, even degenerating into official complaints from the female staff within the mission. It is a negative experience that even the Romanian Army faced during several missions, materialized in reports of sexual harassment that affected both the image of our army and the evaluation reports of the personnel involved in these events.

Sexual jokes - they are generally part of the men's way of life. It is a behavior that is found in the groups from which the soldiers come (colleagues, sports teams, associations). These are seen as ways of integrating newcomers and have different degrees and connotations. In the army, overcoming boundaries generates degradation of group cohesion, creates a lack of confidence in leadership, and has disastrous effects on groups of soldiers. Under the stressful conditions of the theater of war, exposing a military to a degrading situation for him may trigger tragic effects on the other members of the group. The way of addressing, flirting - are generally non-characteristic aspects of the military environment. When someone is confronted with an "atypical, languros" way of speaking, it is preferred to first determine whether it is typical and normal for the individual or is a type of addressing in order to get certain benefits from a situation or career. Flirt is forbidden in the military environment, the way of interaction between soldiers must be maintained at a fair and professional level. In a multicultural environment, gesture and smile, more common in the interaction of individuals in southern European countries, can easily be associated with flirting.

Comments about a person's sexual orientation - is an aspect that is associated with sexual assault. The acceptance by some states of the armed forces of persons with sexual orientation other than declared sex have generated immediate consequences. The living quarters in the mission headquarters, for example, are separated by gender. There have been countless reports of sexual assault, of various types, in male-occupied areas. The presence of homosexuals was considered "aggressive and demasculinating" and, although at declarative level, it is a measure accepted as a result of taxation imposed by international egalitarian policies, in reality it is considered as a factor that diminishes the efficiency of coalition functioning.

Gestures and comments related to specific physical features - referring to different specific anatomical parts are considered verbal sexual assaults and are amended by specific laws. Living in common, stress, sexual deprivation creates conditions conducive to unprincipled observations. There is no excuse for such events, especially knowing that the leadership of the mission has paid particular attention to creating conditions of distraction through sport and sufficient rest time plus the national staff rotation policies in theaters.

Touching and embracing - In some European countries (Italy, Romania, Greece, Turkey) it is a common behavior that people touch one another on the arm, on the shoulder, or to embrace when they revisit without interpreting it as a gesture of privacy

violation. These aspects of interaction are limited to the minimum in the coalition, possibly practiced only among members of the same culture, due to the negative experiences recorded.

The use of diminutives - also falls into the category of sexual assault at a verbal level. Using them to create a custom link only creates both a distorted image of the recipient person and a marginalization of him by the rest of the group, a target of group jokes. It is a discouraged practice irrespective of the military culture of the staff.

Displaying posters with sexually explicit or masked content - It's a point that does not require detail. It is forbidden in the theaters but often practiced in the spaces belonging mainly to men. Not allowed in common workspaces.

Sending self-masquerading or sexually explicit emails, accessing materials or text messages containing sexual content from your computer - it's common sense to avoid such practices at work. There have been no complaints about this subject in the theater of operations.

Comments or role-related behaviors - Extremist egalitarianism has created a strong reactivity to this topic. In Western cultures, the woman is accepted as an equal part of the workforce and is expected to be as competent and competitive as a man, adding to the roles of mother and wife, roles she is expected to be performing at. By contrast, in Islamic societies, women do not have an important role in the labor market. She is subordinate to her husband, and men in general, and her role is only within the family, "the woman's place is only in the kitchen ...". The divergent way in which women's role in society is viewed may generate frictions when forces participating in the mission, including women with rights and responsibilities identical to men, intend to act in a society that does not share the same rights for both sexes. Within male groups, roles are clearly defined, strength, common sense and performance are valued. This dimension has a major role in multinational missions where women are viewed differently in different cultures. Women, regardless of degree or position, because they come from societies where egalitarianism is promoted, have difficulty understanding their exclusion from meetings involving high-level participants in Muslim, traditionalist societies. Making unilateral concessions sometimes goes beyond the level of understanding the rules of the coalition.

Gossip with sexual connotations, compliments - are other ways a person can think that their image has been affected within the group and is entitled to express their disagreement with these unsolicited behaviors.

In the theaters of operations, where attention is focused on missions, there is a risk that sexual assault situations cannot be dealt with all due care, the victim's condition not being the important point of the respective stage of the mission. Being a victim in such situations is perceived by the group as an abdication from the general values of the group: respect, discipline, power and strength to move on even in the most difficult situations and breaking the cohesion of the group. This affects the process of investigation and punishment of the deed.

Victims of various forms of sexual assault develop a varied symptomatology, a consequence of physical and emotional trauma. Sometimes they can be misdiagnosed as being forms of mental illness, all of which have an impact on the victim's careers.

Another consequence of sexual abuse of any form is the total loss of victim's confidence in uniform and sense of isolation.

In 2005, the US Department of Defense set up a special program dedicated to sexual assault in the armed forces: SAPR (Sexual Assault Prevention and Response) in order to increase the effectiveness of the response and transparency of the actions undertaken in support of the victims. Another tool is the creation of a line 24/7 for military service they

can call and notify if their commander ignores the report of the victim. All of these tools are examples from the US military. I cannot assess the importance given by the Romanian Armed Forces to the issue of sexual assault, institutions and instruments created to comply with specific legislation.

Education, communication and awareness of the criminal responsibility of the offense committed are the tools by which the military subculture can minimize these socially and morally condemning facts.

The staff of the multinational coalition is aware of the fact that national laws on the subject have different content and, therefore, the risk of breaking them, resulting from ignorance, is great. For example, US legislation on the various types of sexual assault is very strict and a real psychosis has been created in its application. The culture of European countries is still a protective and polite way of intercourse. Gestures that Europeans are polite for Americans can be offensive.

One of the negative effects of this issue is the aspect of denial, until suppression, of natural roles. This is because of the fear of being "misinterpreted or amended by involuntary behaviors" or by exaggerating the desire for social equality promoted by extremist feminism.

Mutual respect, professionalism, trust, respect for dignity are essential elements for the healthy functioning of the groups. Operational theaters, real missions are the framework in which the validity of these elements is verified. The lack of a correct and active leadership generates group dysfunctions. Assigning time and attention to the problems in the group, following the correct procedures correctly, is part of the responsibilities of the command line staff.

Young soldiers pursuing a military career when faced with problems of the nature of sexual assaults of any kind lose confidence in the military institution and give up their careers in this field and these things only happen when acts of aggression are not punished when lack of leadership and tolerance of abuse create favorable incentives for this type of activity. Cohesion and mutual respect are one way of attracting professional values among the armed forces.

4. CONCLUSIONS

The inclusion of this theme in staff training programs has favored awareness of the legal consequences of such acts. Establishing specialized positions in unit-level process support is another measure of effectiveness in resolving such abuses. The cultural knowledge of the coalition nations is the favored factor of reinterpreting messages initially identified as unacceptable behaviors. Standardizing procedures for such situations is another way of effectively solving such incidents.

The various forms of sexual assault are not only a profound violation of military values but a disturbance of trust in this profession and in this life style altogether. Care and involvement in the relationship with other coalition participants, prevention of sexual assault are part of the objectives of army soldiers and are supported by coalition leaders. Those who notice such issues and do not interfere or report become part of the problem. The phenomenon of sexual aggression is not only characteristic of the army but is a reflection of society in general. The army does not give you morals or standards, they form before you enter this subculture. What the army does is to cultivate a set of values and is likely to amplify preexisting character traits. Sexual aggression can generate large deficiencies in the way the organization operates and contributes to lowering the morale of troops.

EMOTIONAL INTELLIGENCE INFLUENCE IN LEADERSHIP

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Abstract: *In this paper, I analysed the data obtained from an emotional intelligence test I applied to a group of military students and related the results to a survey I applied to the same group of students, which had the purpose to identify the members most qualified to occupy a leadership position due to their qualities and attributes. The purpose of the study is to analyse the importance and influence of emotional intelligence on a group's leadership emergence and recognition.*

The methods I used are both qualitative and quantitative research. The target group consists of all senior military students of the Romanian Air Force Academy, the author of the study being their direct commander. The Emotional Intelligence test was designed by Daniel Goleman, which contains 10 items that represent different scenarios which puts the subjects in different critical situations and the survey has 5 items with open answers that have the purpose to identify the recognised group leaders.

The conclusions highlight the importance of emotional intelligence as a quality of a future leader and verifies the hypothesis that someone who has the qualities of a leader is being recognised by his group.

Keywords: *emotional intelligence, leadership, leader*

1. INTRODUCTION

Emotional Intelligence as a concept, was formulated for the first time by Wayne Leon Payne in 1985. He considered that Emotional Intelligence implies a creative relationship with fear, pain and desire. In 1990, John Mayer and Peter Salovey, two american professors, published two articles in which they tried to develop a scientific method to measure the differences between individuals from abilities point of view. They discovered that some individuals are more able to identify their own feelings and to those around them and also in solving problems regarding emotions. Emotional Intelligence theory started with those researches which combines feelings with rationality and rationality with feelings.

Emotional Intelligence became one of the most discussed subjects in the United States of America after Daniel Goleman, published his book with the title "Emotional Intelligence". Daniel Goleman combined the previous research available with his own result from investigations and came up with a theory that succeeded to give definitions to this concept. He defined Emotional Intelligence as "the ability to understand and control our own emotions and those around us."

Emotional Intelligence is a key ability of a leader. By the end of the studies in the Air Force Academy, a graduate needs to be able to command a platoon. Accepting the responsibility for himself and his subordinates in the military organisation according to high standards requires competencies, initiative, self motivation and trust in his own powers.

His behaviour, reactions, level of communication skills, decision making needs to be done many times under stressful situations, therefore a high level of EQ (emotional quotient) is in high demand.

2. PURPOSE

This paper aims to underline the importance of Emotional Intelligence in leadership development during military studies by evaluating the level of emotional intelligence, a group of senior military students, have reached at the end of their studies.

Another purpose of this paper is to establish a cause – effect relation between the level of emotional intelligence and a leader recognition among a cohesive group. The group of students had been members of the same group for three years.

The first test has the purpose to identify the emotional quotient level of each member while the survey has the purpose to collect the data provided by the subjects regarding the members which have developed the most suited qualities to fulfil the duties of a leadership position within the academy. The leadership position refers to a platoon commander deputy position for a platoon of military students from first and second year of study.

The study was taking place at the beginning of third year of studies for the target group of students. One of the beneficial side effects of this study is that as being the direct commander of this group of students I reached also a better understanding of my subordinates and during the regular counselling and mentoring I had a more appropriate and scientific data to discuss certain issues, individually, also create personalised plans for their development.

3. OBJECTIVES

The main objectives of this study are:

- Collecting and analysing the data obtain from an emotional intelligence test filled out by the senior military students of Air Force Academy "Henri Coandă" – Brașov.
- Collecting and analysing the data from a survey of leadership emergence during their three year period of study within the Air Force Academy and identifying the leaders as recognised by the members of their group.
- Establishing the relation between the level of emotional intelligence from the test with the subjects that were recognised as suited for a leadership position, having the qualities and attributes of a leader, most developed.

Have a better understanding of my subordinates as a direct commander of the target group of the study.

4. RESULTS

The test designed by Daniel Goleman consists of 10 items which presents different critical scenarios, situations that someone can experience. The test completion has as a purpose to emerge the subject into a scenario with empathy, or remember such an experience from the past, the answer to one of the reactions indicated as the most appropriate.

Item 1

The person is in a critical life threatening situation. Three of the answer variants relate to the ability to be conscious of personal emotions, to get to know the situation from the affective point of view and to answer adequately, balanced at unusual or stressful critical situations.

Item 2

A child is very upset, and the adults who stood around him are trying to help him overcome this negative emotional state. Parents, educators or adults in general, who have high levels of emotional intelligence, use the situation to work out their emotions, leading them to understand where the negative emotional state (grief) comes from, what determine to be hurt, to understand what they feel noticing the alternatives they can try in order to find appropriate solutions.

Item 3

An adult subject is in a situation which must be changed in order to obtain some benefits. This test item refers to intrinsic motivation, the ability to develop a plan to overcome obstacles, frustrations and the ability to track a goal. "Hope" is the target as a dimension of emotional intelligence.

Item 4

The scenario presented refers to a person who has repeated failures in a certain direction. Only one of the variants of the answer refers to the degree of optimism which can help the subject to overcome obstacles, to continue with perseverance without blaming himself or demoralize.

Item 5

This situation presented by the test aims the behaviour of the subject towards minorities, his attitude about the ethnic, cultural diversity, just one of the variants of the answer indicate the best way to create an open atmosphere of diversity. The focus of the item is upon the prejudice change through action and through adoption of a democratic model to manage anger.

Item 6

This item refers to the way an angry person can calm. The correct version of the answer refers to the ability of the person, the empathetic way to manage anger.

Item 7

This item represents a situation in which the subject is overwhelmed by aggressiveness, anger. The best response in the event of a dispute is to take a break, interval in which the person can calm down, and thus no longer distorts perception of the situation. After this period, the person may be much better prepared for a useful, productive discussion.

Item 8

While working in a group a solution to a delicate or a tedious problem must be found. The given answer must look like the members of the team need to ensure a harmonious relation, to allow personal idea expression in a natural and creative way.

Item 9

One adult can find himself in relatively stressful situations because, on the one hand, their personal shyness, and on the other hand, a relatively new unusual situation that emphasizes a state of fear. The answer shows the implication of the subject in new situations.

Item 10

A subject which welcome change in their activities is more prepared to engage with pleasure in a new type of action, learns faster how to obtain superior performances.

The Emotional intelligence levels are quantified as follows:

- >100 = Under average
- 100-150 = Average
- >150 = Above average
- 200 = Exceptional

The group of study consisted of 43 subjects, based on their answers the level of emotional intelligence is as follows:

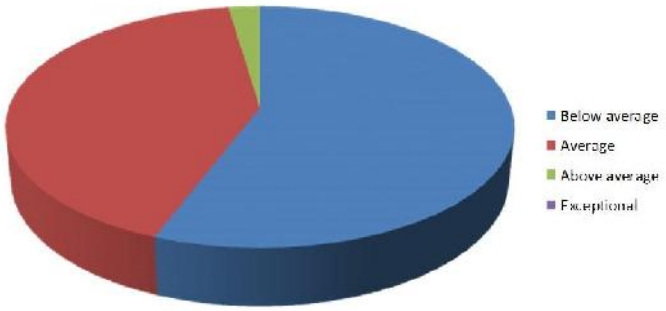

FIG. 1. EQ results

The second part of the study was a survey conducted by their direct commander and author of this study. The survey consisted of 5 items which were focused on identifying the subjects that are recognised as able to occupy a leadership position. Another purpose of this survey was to name the students that are in charge of commanding a group of students organised as a platoon from the first and second year of study.

Item 2 of the survey had the purpose of collecting data about the group leaders' recognition among group members.

Item 2: *Name at least 5 of your colleagues (importance order) which you find best suited to occupy a leadership position. State the reason of your choice.*

From 43 possible maximum answers, the subjects named a total of 14 colleagues that are suited to occupy a leadership position. The frequency was ranging from 1 to 41. All subjects named 5 of their colleagues in the order of importance as they evaluate them. The position they were named which represent the importance was quantified by giving each place an amount of points:

- First position = 5 points
- Second position = 4 points
- Third position = 3 points
- Forth position = 2 points
- Fifth position = 1 point

In the chart below I selected the first 14 frequencies (there were 14 leadership positions available). Subjects were named from 1 to 14 in the frequency order, however the value quantified from the position (as of importance which was a criteria of the survey item).

Table 1. Frequency and value on surveys Item 2

	Frequency	Importance value	EQ
Subject 1	41	180	140
Subject 2	34	115	100
Subject 3	28	85	105
Subject 4	25	86	140
Subject 5	17	59	150
Subject 6	16	29	105
Subject 7	15	32	120
Subject 8	14	41	105
Subject 9	11	24	80
Subject 10	9	22	100
Subject 11	8	18	120
Subject 12	6	13	85
Subject 13	4	12	105
Subject 14	4	6	120

5. CONCLUSIONS

After conduction this study, I draw the following conclusions:

- 56% of the student have an under average level of Emotional Intelligence, which needs to be developed through special curricula during their studies such as giving them as many possibilities as possible to discover the best course of action in multiple situations.
- The 14 subjects that were acknowledged as suited for a leadership position scored majority in the average range:
- 1 above average
- 11 average
- 2 below average
- Emotional Intelligence is a major factor in managing human interactions and moreover, leadership.
- The hypothesis that in order to become a good leader, a person needs to be recognised by his group, regardless his expertise (the 14 subjects are not all the ones with the highest grades and marks from the group).

At first glance, the fact that % of the students that participated in the research scored below average, might look suspicious. However, the EQ test that was used in this research is a test for adults. The participants age of the study group ranged from 20 to 23 years. Their age underlines the fact that in order to have a high EQ we need to pass through a series of development phases grounded on life experiences.

The group of 14 individuals who were identified as suited to occupy a leadership position within the academy, scored predominantly above the median of the entire group.

Emotional Intelligence is considered a powerful indicator for the standards they will reach in the management of human relations and also shows a disposition for one to become the leader of his group. A leader of his subordinates is understood beyond the formal authority that resides from rank and formal position. Emotional Intelligence is a part of the foundation on which, competencies are built, competencies that favours his recognition and appreciation among the members of the group or team.

The classifications resulted from grades, make no importance on who becomes a leader. The group I identify as suited for a leader position are not the group with the highest grades, therefore we cannot claim a causality between the grades obtained through evaluations and the recognition among a group as leaders.

It is well known that the correlation between inter – section researches, cannot prove causality, especially in the situations when we don't know which variable came first. Therefore, it is not suited for me to make the affirmation that EQ level is the cause of leader emergence or appreciation as suited leaders within a group of individuals. Higher EQ leaders are more likely to make better decisions, engage and influence more effectively and create the right atmosphere for the task received. Emotional Intelligence is a core skill grounded in science that emphasizes performance. Studies show that between 48% and 80% of what differentiates high and low performing leaders can be attributed to EI.

The decisions we make in our military life are many times based on our emotions and emotional intelligence. It makes sense that when individuals have a great sense of communication and organizational skills, they will be lead to having the ability to make proper decisions and interactions with others. Emotional intelligence is a trait that can always be nurtured and strengthened in all of us, but without having a developed sense of it, the individuals will lack social functioning.

Becoming more aware of the impacts and the differences of our own EQ and IQ can make us better leaders because being true to oneself is the best starting point in any form of development, for leadership as a bigger goal. In this global age, it is necessary to compile a high sense of emotional awareness.

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CIMIC CAPABILITIES AND STARTEGIC COMMUNICATION

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Abstract: *Starting from the idea that public events reflect social order, civil-military relations had and still have evolutions and manifestations varying according to the country in which they have exercised their capabilities. Moreover, civil-military cooperation has suffered in time, changes in approach and perception. Current concepts such as strategic communication and fake news are broadly approached in the present paper, in close relation to civil-military cooperation. The multinational character of the missions also attracts multiple relations with a high degree of international cooperation, especially at tactical and operational levels. Furthermore, the effectiveness of coordination and cooperation at strategic level in case of CIMIC missions, between states or state structures, organizations and alliances is also a determining factor in the success of a mission. Bringing this strategic level into discussion requires raising the communication standard to a required level by means of Strategic Communication.*

Keywords: *CIMIC, StratCom, fake news, public sphere*

1. INTRODUCTION

Due to the increasingly diverse background of the people that the military profession will attract as future members, military professionalism is and will be measured less by engaging in a narrower ideology and more by being able to reach a common denominator related to various belief systems and military service requirements. From American perspective, the ethics of professional is best served not by seeking an extensive ideology shared by all of them but by recognizing that military service is compatible with a wide range of political engagements, even if they are not loudly expressed in the public sphere. Moreover, they have to find that harmony between personal beliefs/commitments and military service requirements. This bridge has already been created by belonging to a greater common good that overcomes personal interest.[2]

1. STATCOM MANIFESTATIONS IN UE

Elements that belong to *StratCom* are found in Russia atitude towards the so-called Islamic state of Irak and Levant (ISIL), these representing the propaganda and promotion of *fake news.* The difference in attractiveness between Russia and the EU had to be diminished by improving Russia's position – in particular by promoting the "Russian World" (*Russkiy Mir*) – and, at the same time, by discrediting EU. This was to be achieved through the development of promotion mechanisms through mass media, non-governmental organizations (NGOs) and other key actors – from business lobbies to political parties.

Russia focused on the attack rather than on the advertising itself, thus reaching social groups disappointed with politics and the economic situation in Europe. Russia's strategic communication is based on a "meta" story or an elaborate one, a series of basic themes that consistently appear in most of the communication efforts. Although not all of these themes resemble each other, there is a number of recurring stories from which the Kremlin has inspired it and which were promoted systematically. Therefore, the EU is portrayed as close to disintegration as possible under the combined pressure of the fiscal and migration crisis. The Union is described as a monster incapable of making decisions because of the waves of expansions to the East. This type of message tries to respond to certain audiences within the EU. Moscow's end goal is to convince the European public that the EU is focusing on Russia's imagined threats and neglects the real ones in the south. Russia is also regularly involved in other controversial political issues in Europe. Any potential split or real division within the EU is amplified. The refugee crisis is one of the relevant examples: Russia has attempted to amplify the issue, claiming an anti-refugee position approaching absolute racism, while suppressing any information inside Russia that could damage relations with its own Muslim communities.

A second bottom line targets the leaders of the Member States and the EU institutions. The more European leaders seem less good, the less likely the EU will be, and the more impressive the Russian leadership will be. Thus, campaigns in Russia are trying to create a bridge between the Eastern Partnership states and their close neighbors in the EU. They often use local media stories about territorial claims (for example, by Romania or Hungary against Ukraine) or other security threats (for example, "Roma gangs" in Romania). In Armenia, Azerbaijan and Belarus, Russia supports the deep fear of local elites to change the orchestrated external regime. In contrast, in Georgia, Moldova and Ukraine, Russia uses uniform messages about the destructive consequences of *Deep and Comprehensive Free Trade Agreements* (DCFTA) and visa-free regimes.

Russia also has a rather complex communication strategy – and significant infrastructure – in large parts of the Western Balkans. There are also a number of Moscow-funded media groups (though not openly) that promote Kremlin's vision of the world, in combination with conspiracy theories and Serbian ultra-nationalism. Considering all these anti-EU actions, the latter set up the East StratCom Task Force, focusing on Russian disinformation, based on the *European External Action Service* (*EEAS*) in 2015. It is composed of nine communication experts, good Russian language speakers. Team members mostly come from EU institutions. The Task Force seeks to create a positive image of the EU through strategic communication campaigns focusing on EU action in the region, revealing and deconstructing conspiracy theories and combating misinformation. Structure actions target the EU's eastern neighbors, not the Member States themselves. It publishes articles in "Disinformation Review" and "Disinformation Digest" weekly. These are promoted via a Twitter @EUvsDisinfo account, with thousands of followers and monthly impressions.

If the EU has so far only acted on a national level, it has recently been observed that coordinated action at EU level has been successful, especially when the challenges are addressed to the Union as a whole, and these can not be tackled separately. EU Delegations (as well as Member States' embassies) have used partial strategic communication with minimal involvement. However, external communication and public diplomacy have become a key priority with the establishment of the EEAS.

This effort is also supported by outsourced help from consultancy firms when it comes to strengthening communications across the web and social networks.

So if we were to ask whether *StratCom* exists at EU level, we can say that there are hesitant intentions and already effective actions put into practice, but the already existing concept and its implementation need to be developed to counter *fake news*, misinformation, and so on, all in a joint effort to raise awareness and involve EU Member States. From an EU perspective, strategic communication finds its definition in the *Strategic Communication Action Plan* adopted in June 2015. According to the document, this type of communication represents "*an important tool in promoting the EU's overall policy objectives*"[3]. Strategic communication has become a priority in developing response capabilities, aiming at promoting the fundamental values of the European Union.

In case of Great Britain, the Ministry of Defense proposes two definitions of *StratCom*. The fist defines it as "*Developing national interests using all means of communication in defense to influence people's attitudes and behaviors*", and the second one, as "*Systematic and coordinated use of all means of communication to achieve UK national security objectives by influencing the attitudes and behaviors of individuals, groups and states.*"[3] Therefore, the purpose of the British StratCom aims primarily at a national goal, mainly focused on three internal instruments of power, namely diplomatic, military and economic. This helps to achieve the strategic objectives of the state, with the significant involvement of the Ministry of Defense, which has two functions: the State Department and the Strategic Military Command. There are 5 types of strategic communication used by the British: 1. public messages designed to encourage and build trust in the defense institution; 2. activities to engage individuals, communities and businesses in the United Kingdom to inform, alert and conduct behaviors that increase resistance; 3. activities designed to change attitudes and influence the behaviors of individuals and groups; 4. activities that reduce the probability of actions against British interests by building an international influence; 5. communication in support of diplomatic efforts to influence friendly or hostile states.

Therefore, strategic communication derives from politics and strategy, but operates in an information environment being seen by the UK with two great facets: the domains (cognitive, physical, virtual) and the interdependencies between them:

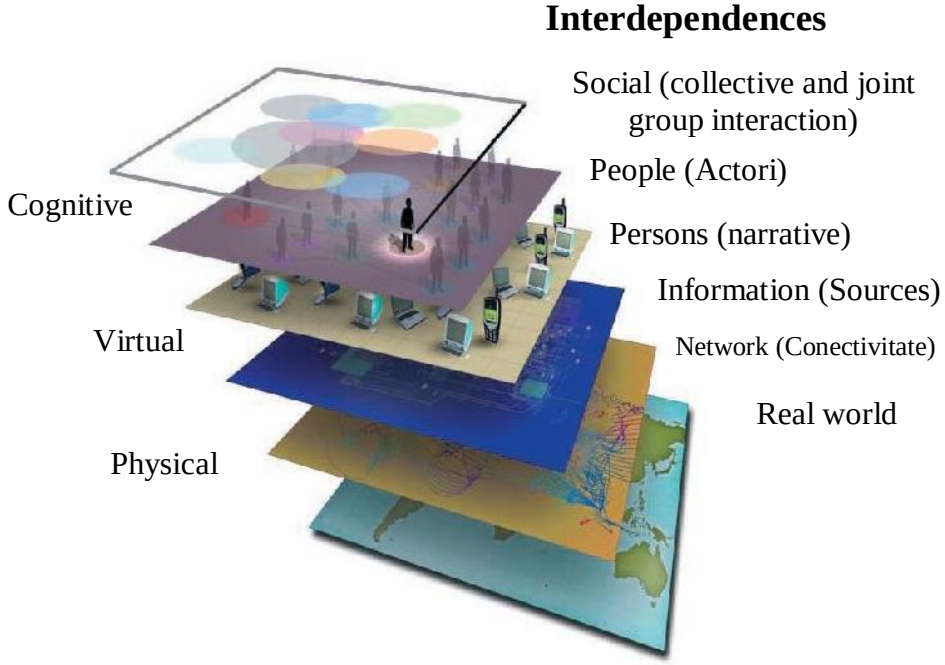

FIG. 3 Information sphere (JDN 1/12, pp.2-4)

The first facet consists of entries in 3 domains: the cognitive domain – as we think; the virtual domain – the way we communicate; and the real world of how we interact as national states, cultures and societies – the physical realm. The second facet is the relationship between 6 elements/layers of the environment. They are represented by: the real world and its events, the network connectivity that provides information; the information itself and the person who lives in the environment and who develops the accounts within it, as well as the actors and social groups (both collective and common) who interpret and exploit the environment.[4]

These elements of the information sphere are not enough for *StratCom* to be efficient. In British vision, it also requires an understanding of the public through the cultural aspects of the physical domain, the functioning of the virtual one, and the way in which employment is perceived in the cognitive field. Thus, communication is accompanied by an assessment of the availability, reliability and vulnerability of the communication infrastructure; an assessment of the communication channels best suited for broadcasting the message; and target audience analysis, so that a message is delivered to the audience. The information sphere becomes a challenge and therefore requires constant reassessment. Analyzing the perspective of Great Britain, it is clear that ideas must be communicated in competition with others to ensure security objectives and supremacy in conflicts. This involves mastering the way in which audiences think, communicate and come together, as well as the cognitive, virtual and physical aspects of the informational environment. The culmination of strategic communication from a British perspective includes a set of elements: a combination of clear and credible strategy, engagement and understanding of the public, the use of communication channels, the selection of information, the mastery of message creation and the ability to synchronize in its communication. In the case of missions outside the national territory, *StartCom* does not imply engagement only at the strategic level, but also tactical, ground level, efficiency measurement and feedback assessment. In this process of building and understanding strategic communication both the Ministry of Defense and the government and other government departments are involved. In this case, if it is desired, at the UK level, to achieve strategic communication in order to reach strategic objectives, there will have to be an influence and impact of information in both the military strategy and the operational plan.

The United Kingdom operates at the national level with three instruments of power (diplomacy, armed force and economic capacity) for achieving the strategic objectives, informing them not between themselves and being treated differently. The importance of strategic communication is not omitted, as is emphasized in the doctrine mentioned above (*Joint Doctrine JDN 1/12 - Strategic Communication: Defense Contribution*), promulgated in 2012 where this communication becomes effective when all ministries are working together, when messages are transmitted in public sphere and when actions are synchronized. In this respect, the Ministry of Defense has the task to coordinate specific communication objectives by means already known and mentioned above: information and public relations, psychological operations and information operations, civil-military cooperation, public diplomacy, presence actions, posture and profile such as *show of flag* or *show of force*, exercises and missions in theaters of operations. Thus, the definition given by the British defense ministry is clear enough: "*promoting national interests by using all means of communication of the Ministry of Defense to influence people's attitudes and behaviors*". [5] So, the UK model is one of inter-institutional communication integrated at governmental level in order to ensure national security.

2. STATCOM AND USA

The US *DoD* (*Department of Defense*) approach aims at a larger framework than the national one. Thus, the concept of joint integration of strategic communication proposes how a joint forces commander, during a foreseeable period 2016-2028, could plan and execute joint operations to achieve strategic communication objectives in the context of a wider national effort. In this spirit, strategic communication focuses on the efforts of the US government to understand and engage the key public in order to create, strengthen or maintain favorable conditions for enhancing US government interests, policies and objectives by using coordinated programs, plans, themes, messages and products, all synchronized with the actions of national power tools. [6] A real challenge for this approach is the integration of all joint force actions and other operational capabilities to maximize their combined effect and to coordinate these actions with those of any other partner. Depending on the situation, the partners of the joint force may include various US government departments and agencies, multinational governments to include a host country, non-state organizations, academia and industrial trade. The joint force communicates strategically with partners and opponents, with populations, governments and other organizations in different contexts: conflict, cooperation or competition. Strategic communication is largely driven by influence that, in the US, covers a wide range of activities, including simple information, education, conviction, inducement, and coercion through words and actions. As a mechanism for exerting influence, communication is a complex phenomenon. In the case of strategic communication, the US Joint Force has four main objectives: 1. to improve US credibility and legitimacy; 2. to weaken the credibility and legitimacy of an opponent; 3. to convince the selected audience to undertake specific actions that support US objectives. or international; 4. for the performance (or not) of specific actions by a competitor or opponent. [7]

These goals are part of a *DoD* perspective that does not provide conclusive answers, but attempts to stimulate informed discussions and experiments to discover a set of common shared capabilities with regard to *StratCom*. This conception provides only a possible approach to how joint forces should address strategic communication, thus being defined as an exchange of meaning in support of national interest, in which influencing is the fundamental challenge, with the different forms that it takes and for which effective integration of all available means is needed. It is strengthened by nine principles of communication based on: leadership, understanding, universality, dialogue, effort, results, continuity, credibility and receptivity. Therefore, in the case of *DoD*, strategic communication is seen as an adaptive and decentralized process in an attempt to understand the selected audience by hypotheses of physical or informational signals that will have the desired cognitive effect on the audience concerned, testing those hypotheses by action , monitoring effective outcomes through feedback and rapid dissemination of the best solutions through force. [6]In the case of the United States of America, the *fake news* phrase is already a phenomenon, the public does not know what is real and what is misinformation, the images and videos are processed for the desired purpose (it is a phenomenon out of control, manipulated by institutions/ States for the continued denigration of the US president). The Naval War College in Newport, USA, studied closely and deepened the *StratCom* problem and supported the requirements of the Department of Joint Military Operations. It has thus come to the conclusion that there is a need for the ability to convey messages and information that create a favorable environment for the US and its allies. In this regard, the US Army needs a doctrine that establishes the foundation of the analysis and communication function with which it can be fully successful in the communication environment.

Moreover, this doctrine would lead to an understanding of strategic communication and how it should be used at the joint operational level. [7]

In NATO terminology, StratCom is an integrative concept, whose purpose is to coordinate and synchronize all communication activities or relevant from a communication point of view (special events, exercises, operations, etc.) carried out by the Alliance and allies with the purpose of shaping the informational environment in support of the fulfillment of its own political and military objectives. According to *NATO ACO Strategic Communications Directive* [8], *StratCom* actually includes all the activities and capabilities of information-handling structures: public diplomacy, military and civil information and communication, information operations and psychological operations. Therefore, *StratCom* is an integrating function to contribute to the achievement of the objectives of NATO operations and activities. This strategic communication emerged as a necessity of the current security environment, the rapidly growing information environment, the evolution of mass communication technologies and the expansion of the use of social networking. Therefore, real-time coverage of the effects of fighting can have a major (positive / negative) impact on the conduct and conduct of military operations. Moreover, if we consider the fake news phenomenon and the deliberate alteration of the informational content of the messages for public information, they can contribute to the achievement of certain political objectives.

For NATO, public opinion information is important and has been reiterated since the Bucharest Summit in 2008 and including that in 2016 in Warsaw. Allies' declarations at these meetings included prioritizing adaptation to security threats and strategic communication that is seen as "*an integral part of our efforts to achieve the Alliance's political and military goals*." [9] The framework of strategic communication is seen as an integrating element: public diplomacy, information and public relations, psychological and informational operations. In the latest *NATO Military Policy on Strategic Communications / MC 0628*, adopted by the North Atlantic Council on 19 July 2017, the theoretical and principled framework for the organization of structures, assignment and unitary deployment of complex activities under the umbrella of strategic communication at NATO level as well as in military operations led by the Alliance. In this document it is stated that "*in the context of the military activities carried out by the Alliance, strategic communication is the integration of communication capabilities and command information function with other military activities to understand and shape the information environment in support of NATO goals and objectives*". [10] In this context, the role of these Allied Committees is to manage communication and information capabilities in a uniform way, and to synchronize relevant military activities from the communication and communication point of view, as well as to carry out information activities in order to produce certain effects on different types of audiences. Therefore, in order to enhance the coherence of planning and the implementation of activities with an impact on the informational environment, the strategic communication framework is defined as "*a management responsibility, which extends to all levels*." [10]

Communication in military operational planning is very important, with the support of public relations, psychological operations, information operations as well as civil-military cooperation, presence, posture and profile activities, hiring key leaders, masking and inducing opponent error. All this is done through a specific communication, in order to produce a certain impact on an informational environment and the audience, by some means to achieve the desired effects (information, influence, misleading). Acts of communication have certain meanings, with military implications. A clear and very current example is the messages for public information related to national and / or multinational exercises and missions.

These deployments of military forces that are demonstrably deployed also have a communicative value in order to discourage or transmit a message, that of physical presence in the area. Therefore, "*The environment is the message!*" [1], reflects the importance given to actions and their valorisation through strategic communication – *Action is the message!*

CONCLUSIONS

Based on the experience gained over time, strategic communication aims to communicate as effectively as possible to audiences, public institutions and the media, to achieve strategic, political and military goals. The framework of strategic communication also emerged as a need to adapt the messages to the specifics of the recipients as well as to integrate all communication activities as well as to synchronize them with the actions of the military operations in order to fulfill the political and military objectives. Communication becomes strategic when it serves political-military purposes when it is applied uniformly to achieve the strategic goals pursued. At the national level, communication becomes strategic when it goes beyond institutional public communication, with the aim of supporting national politics by fulfilling its objectives at all levels: political, diplomatic, economic, educational, informational and cultural.

Strategic communication harbors more valences and a complex and complete view of the operations underway in the US, Britain, NATO and the EU. Thus, after the March 2017 edition of the *Dictionary of Military and Associated Terms*, edited by the US Department of Defense, strategic communication is defined as follows: "*The United States Government's concentrated efforts to understand and engage key audiences to create, strengthen, or maintain favorable conditions to promote US Government interests, policies and objectives by coordinated use of programs, plans, themes, messages and products in a synchronized way actions of all instruments of national power*".[11] Thus, *NATO StratCom Framework* [12] is seen as a mix of individual contributions that are synchronized and coordinated. This process involves military and civilian institutions, governmental and non-governmental organizations that contribute to areas such as public affairs, public diplomacy, military intelligence operations, civil-military cooperation, and beyond.

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HYBRID WAR AS A MODERN INSTRUMENT OF MILITARY ART

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Abstract: *The security environment in recent years has been characterized by a range of asymmetric threats that bring to military analysts' attention strategic issues that are a lot more sensitive and controversial than they used to be. The distinction between conventional and unconventional, symmetrical and asymmetric has become harder and harder to define, whereas asymmetric threats have become diverse due to the state-of-the-art technologies.*

Today's conflicts no longer focus on the physical defeat of the enemy, namely the physical combat. Nowadays, the war focuses on the human psyche, acts of terrorism accomplished through sophisticated, subtle and destructive methods. The hybrid war belongs to one of these tactics. It is an instrument of the military art, an implementation of procedures and knowledge acquired by the performer. The authors aim to approach some of the characteristics of the hybrid war, starting from its definition and manifestations.

Keywords: *military art, irregular war, capabilities, strategy, hybrid war, NATO, vulnerabilities*

1. INTRODUCTION

Ancient, modern, conventional, or hybrid, the war is complex, diverse and unpredictable. The specialized literature defines it as a social and historical phenomenon, which often represents the most virulent forms of the quintessence of political relations between militarily structured human groups, whose purpose is varied and sometimes inconsequential, of economic, political, religious or territorial nature [1].

Beyond any definition, throughout our existence on earth, the war has been a crude mixture of threats and coercive instruments with a political background, a challenge to the world security.

Similarly, hybrid war that we is a matter that we are invoking more and more often today, seems to be a new art of waging war, a new form of manifestation of a military conflict. A somewhat new concept, but perhaps only its name is new, if we think of the meaning of the adjective **hybrid**: *"made up of disparate elements, lacking harmony"* [2, 3].

The war has always been a destructive, annihilating, disastrous phenomenon in relation with people, holding major implications on the present time, but most often on the future. It is, in its strictest sense, *"a violent action (...), not only a political decision, but a real political instrument, a continuation of political relations, one of their achievements through other methods"* [4].

In the 21st century, within an armed confrontation, the military art has passed from the usage of existing means, as the Prussian theoretician Clausewitz had foreseen, to the real implementation of theory or data related to methods, processes and principles of military actions. The new physiognomies of the conflicts have shown that the armies based on the Prussian model are no longer effective.

Consequently, there was need for a paradigmatic reform of the armed forces structure, understood as a general term, for these forces to adapt to the evolution of the security environment. All these metamorphoses take place in a harmonious, creative, well-established manner that leads to the achievement of the desideratum.

The progress of science and technology over the past thirty years has also changed the functions of the military field, where, in addition to military science, military art – its strongest component – had to rediscover and to redefine itself quite quickly to resist and face new types of violence. The hybrid war, this latest physiognomy of a confrontation, not only military, but also psychological or even social, has its principles, most of them unbeatable and unpredictable: information supremacy, through which any action of a third party can be annihilated, accomplished by surprise; technological predominance; conflicting symmetry (politics, strategies, doctrines similar to conflicting parties); dissymmetry, asymmetry.

In the light of all these considerations, we believe that particular attention must be paid to the risks to which a hybrid war may expose us. These hazards may be of military nature (mass destruction weapons, massive arming) or non-military (precarious states, ethnic and religious disputes, complexity of the environment, corruption or illegal immigration).

2. CHARACTERISTICS OF THE HYBRID WAR

Once with the forced and quite sudden annexation of the Crimea by Russia, in 2014, the Western strategic perception, in particular, adopted the concept of hybrid war. The term, so far, has not been given a clear definition, yet, a series of analysts in the field oscillate between a conventional war and an irregular war, or between a symmetrical one and a non-symmetrical one.

Should, at the operational level, the feature of such a battle consist of complex and varied maneuvers, focusing on the concentration and deployment of combatant forces, at the tactical level, the hybrid war is a conglomerate of conventional instruments and equipment adjusted to modern and current technological contexts. This mixture, perceived as a *hybrid*, proved to be efficient in Ukraine, namely for the benefit of Russia, whereas in Iraq and in Afghanistan, it was useful for the ISIS terrorist group. In other words, the hybrid war is Russia's strategy in Crimea, respectively, the resounding campaign of the Islamic state in the Middle East.

Chronologically, the phrase – hybrid war – appeared in 2005. Two US officers were the ones who spoke about this new form of an armed conflict [5] in an article describing the increasingly virulent and violent ethnic conflicts, initiated by radical terrorists. Considered a fourth-generation war, hybrid war is different from the classical, conventional armed confrontation. It is a hybrid of conventional and unconventional methods, tactics and capabilities, violent actions and unlimited terror. If the World War I was focused on the use of numerous masses of people (first generation war), the invention of the armored vehicles and aircraft changed decisively the fate of an armed conflict in the years of the World War II, (second generation), whereas the technological power of the post-war years generated new mutations at the level of war concepts and military confrontations (third generation).

Thus, nowadays war, the hybrid war, is one of the information era [6]; it is set up in a context of virulent insecurity. A *continuous warfare*, whose manifestations have changed in time and space, accentuating and speculating relationships *"between individuals, communities (states, alliances, religious, ethnic, professional entities, etc.), between individuals and communities, to impose one's interests at various levels: power, influence, territories and resources (human, material and financial)"* [7].

The concept of hybrid war, as we have previously mentioned, is not fully defined. There are, however, several approaches to this phenomenon, issued by security bodies or by political-military analysts. Thus, according to the NATO, hybrid threats *"are represented by those adversaries who have the capabilities to use both conventional and unconventional means simultaneously to achieve their goals"* [8].

In the work *"Conflict in the 21st Century. The Rise of Hybrid Wars"*, the definition of hybrid warfare focuses on the adaptability of opponents – non-state actors – to armed clashes, by using military capabilities and methods (use of force) and non-military ones (irregular tactics, terrorist actions) to achieve success [9].

Another definition of the US military explains the hybrid war as being *"a combination of symmetrical and asymmetrical armed conflicts, where the intervention forces carry out traditional military operations against enemy military forces and targets, while acting simultaneously and decisively for gaining control of the indigenous population in the theater of military operations, through stability operations"* [10]. In addition to this perspective, a researcher at the Center for International Strategic Studies, Nathan Freier, describes the hybrid war as a confrontation involving four threats: *traditionalism, asymmetry, catastrophic terrorism* and *disruptive terrorism*, due to the use of technology in relation with military superiority [11].

From the set of more or less exhaustive definitions of this phenomenon, named hybrid war, there results that, in a confrontation of this type, success can be achieved in a direct, palpable, visible manner, most often at the cost of loss of life. Targets are populated areas, subway stations, stadiums. An international community that unfortunately can only witness actions but it and cannot react. This piece of truth makes us conclude that, in the hybrid war, on the one hand, it is military weaknesses that are being *"exploited"*, while on the other hand, there are non-military (societal) vulnerabilities that the aggressor feels and targets: ethnic and religious tensions, inefficient and corrupt institutions, economic or energy dependence, etc. Thus, starting from these weaknesses, a hybrid war will involve various actions, ranging from terrorism to media propaganda, through irregular military actions very rarely if ever assumed.

The main characteristic of the hybrid war is coding. We have no war declarations; we do not have diplomatic talks. Everything happens at an amazingly rapid pace, which sometimes may appear even illogical! Codes and symbols seem to make up the background of war. Unlike other forms of war, the hybrid war emphasizes the economic environment of a state, supported by propaganda that includes religious messages: Orthodoxy against Catholicism, Islam opposing Christianity, and Islam versus Hinduism. Hybridity is a strategy that uses this combination of means against a state: conventional forces, governments destabilizing, Special Forces, intelligence agents, cyber, criminal, paramilitary, and terrorist activities. The goal is an offensive and a global one against a state, an institution or an organization.

3. NATO: A SECURITY CHALLENGE

In July 2006, Israel experienced a hybrid war. The Hezbollah Movement then demonstrated the power of its capabilities by implementing its own technologies: anti-tank missiles, drones, all of which were amplified by a well-managed propaganda and the tactical skills of those who organized the action.

The conflicts of the twenty-first century have led to profound transformations of the conventional war concepts. The post- cold war unipolar order has led the US and its allies to prefigure and adopt a different approach to the reality of armed confrontations from the psychological, legal and, most importantly, strategic point of view. The hybrid war is silent, hidden and insidious. It uses conventional military forces combined with a series of unconventional tactics and, as a central point, cyber elements. This is, at a quick glance, a possible difference between a symmetrical, linear conflict, in which everything is planned, and the asymmetric, nonlinear conflict, in which we witness a simultaneous use of military and non-military tactics. We are talking about accomplished actions, such as the annexation of the Crimea by Russia, an action unrecognized by the US and the EU Member States, but it is a reality that we now witness and whose consequences we experience. It was a *"silent"* annexation, without the use of weapons, only through the support of paramilitary groups and detachments of Russian and indigenous activists led by Russia.

What is NATO doing? How does it react in case it does?

We infer or we expect answers to these questions. NATO is a political-military organization, as we know. It needs to adapt to all changes in the security environment, especially in situations of global uncertainty.

Some answers appeared in the summer of 2014, when, at the Newport Summit, the Alliance announced a new security action plan with regard to the situation in Ukraine – a *"very high"* readiness joint task force in Eastern Europe, a *"lance peak"* to include 3-5,000 troops available within 48 hours [12]. The NATO Secretary General of that time, Anders Fogh Rasmussen, asserted that *"we have to give a clear message to any potential aggressor: the attack against any of the allies will face the reaction of the whole Alliance."* [13]

Should an answer be found, it will consist of the states' resilience against dishonest propaganda, and against subtle attacks to their lives.

4. CONCLUSIONS

From the Trojan horse to the virtual space nowadays, the world has witnessed numerous phases of the hybrid war. The difference is that those stages were never referred to as hybrid. However, they were marked by hidden, cunning, and ultimately violent threats. Weapons or one-to-one combat are no longer sufficient to conquer a state. The fight does no longer occur on land; it has moved at psychological level and it involves conquering people's minds, feelings and attitudes.

Hybrid war is never declared. Real weapons are replaced by nonmilitary instruments. As a member country of the NATO and the EU, Romania needs to be aware of its exposure to the most diverse attacks, from public opinion manipulation to cyber attacks. We are part of the NATO, but we are also part of this unconventional war.

What is the hybrid war? A non-linear battle of the 21st century. The actions in Ukraine awakened the Europeans. Perhaps it is time for NATO and the EU to take advantage of this situation. A coordinated defense planning could generate benefits, not competition.

The best strategy to oppose hybrid war is to prevent it. Through an effective and objective coordination between the two world organizations, most of the hybrid actions could be countered. Thus, peace and security would be assured in the Euro-Atlantic area.

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