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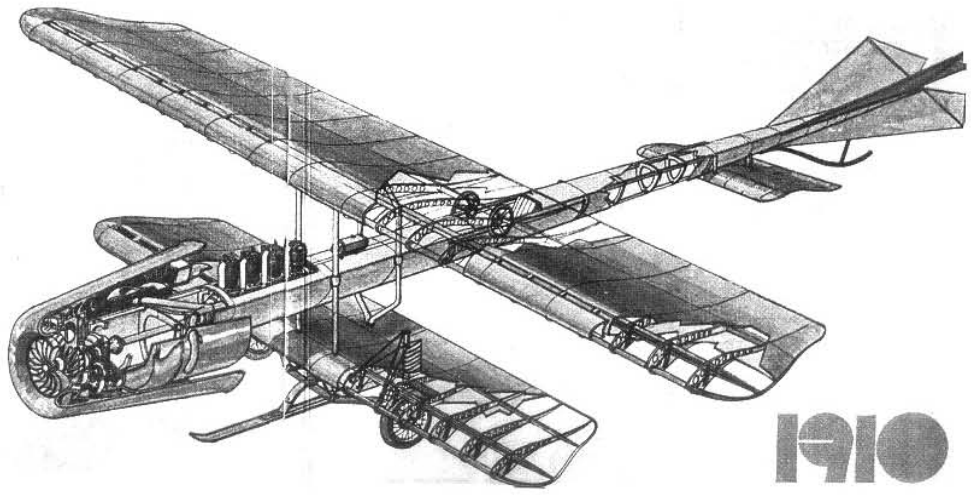

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Phone: +40 268 423421, e-mail: editura@afahc.ro

C O N T E N T S

UAV COMMUNICATION PROTOCOLS AND QUALITY OF SERVICE IN 5G COMMUNICATION

Ovidiu PĂSCUȚOIU[*], Maria-Daniela TACHE (UNGUREANU)[**]

[*]"Henri Coandă" Air Force Academy, Brașov, Romania (ovidiu.pascutoiu@afahc.ro),
ORCID: 0009-0009-6918-0218
[**]"Politehnica" Bucharest National University of Science and Technology, Romania
(danielatache26@yahoo.com)
ORCID: 0009-0003-4588-8824

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Abstract: *This paper aims to provide an overview of common network protocols in UAV communications with a focus on security and vulnerabilities. In order to assess the common types of vulnerabilities, various elements must be taken into account such as mission purpose, communication type and protocol. The paper will walk through the main types of UAV protocols and make a brief analysis in terms of communication network security. It will also look on 5G communication requirements in terms of quality of service.*

Keywords: *Communication, Security, Networks, Vulnerabilities, Layer security, Data, UAV, Protocols*

1. INTRODUCTION

UAVs (Unmanned Aircraft Vehicles), commonly known as drones use specific protocols for communication with base stations. Over the last years, the increasing amount of UAVs missions both civilian and particularly military has raised the importance of UAV communication. More and more real-world applications use UAS (Unmanned Aircraft Systems) as a modus operandi; thus, UAVs as a part of UAS have become nearly indispensable to today's demanding complex operational activities such as air surveillance, intelligence, transportation just to name a few of them. In order to properly conduct communications between UAVs or inside an UAS (between UAV and base stations), communications must ensure an acceptable level of security. Bearing in mind that fulfilling an objective according to standards must be done within a certain level of security, this paper aims to have a quick look at most common UAV communication protocols from the security perspective. UAV-to-UAV and UAV-ground control station protocols will be presented in this paper.

2. LITERATURE REVIEW

As seen in the image above, aeronautical communication involves many types of communication whether we are talking about air to ground communication or air to air data transmission.

Some relevant paper regarding UAV communication include:

- [1] which describes UranusLink protocol from both architecture and security perspective;

- [2] presents some cyber-incidents identified within UAV communications from the military perspective;
- [3] describes different types of protocols used in drone swarm communications;
- [4] describe MAVLink protocol using ArduPilot Mega (APM) 2.8 is for conducting an experiment to demonstrate MAVLink features;
- In [5] the authors present the system architecture of the SUNNY project consisting of four UAVs communicating using DDS protocol;
- [6] make a security comparison between DDS, TLS and DTLS protocols outlining the key security components of DDS protocol.
- [7] present vulnerabilities on the MAVLink protocol.
- In [8], the authors propose a security-enhanced version of MAVLink called MAVSec which ensures confidentiality, availability, and integrity.
- [9] make an analysis of MAVLink protocol performance on ships.
- [10] make a comparison analysis between MAVLink, UAVCAN and UranusLink protocols in terms of architecture and security features.
- [11] present a survey through UAV communication vulnerabilities and types of attacks.
- [12] present D2GCS protocol security features.
- [13] experiment a DoS and hijack attack on UAV exploiting vulnerabilities on MAVLink protocol.
- [14] present a UAV 5G communication solution using a four antenna UAV coverage.
- [15] present a solution to encrypt MAVLink protocol using ChaCha20 as the encryption algorithm.
- [16] present a detailed analysis of UAV vulnerabilities.
- [17] propose a keystream cypher in order to enhance UAV communication through MAVLink protocol.

3. UAV COMMUNICATION PROTOCOLS

Most common protocols used in UAVs communication are:

- UranusLink;
- UAVCAN (Cyphal);
- MAVLink;
- DroneLink;
- DDS;

UranusLink as described in [1] is a communication protocol used for exchanging information between an UAV and a base station. The packet structure needed for transmitting data contains the following fields:

- Preamble;
- Sequence number;
- Message identification;
- Data Length;
- Data as such;
- Checksum;

UranusLink is a stateful protocol as it establishes connection between the UAV and the base station using a handshake mechanism. A secure version of this algorithm assumes that a symmetric algorithm such as AES will encrypt Message identification, Data, and checksum, leaving the other fields unencrypted in order to not alter the data

transmitted. Although challenges arise regarding the exchange of encryption keys, the algorithm itself can be considered secure as it provides a connection oriented, safe way to transmit information in order to be able to control an UAV from a base station.

UAVCAN or Cyphal [18] is a lightweight, open protocol for distributed communication among various types of intelligent vehicles including UAVs. The communication uses a client-server architecture and contains the following information needed for exchanging data:

- Payload;
- Data type ID;
- Client node ID;
- Server node ID;
- Transfer ID;

UAVCAN uses UDP as ISO/OSI transport protocol.

One of the most used protocols is Micro Air Vehicle Link Communication Protocol (MAVLink) which is a bidirectional communication protocol used for controlling UAVs from a ground control station. One ground control station can control up to 255 UAVs using MAVLink. The packet in version 2.0 contains 12 flags:

- Start;
- Payload length;
- Incompatibility flags;
- Compatibility flags;
- Packet sequence;
- Sender ID;
- Component ID;
- Message type;
- Data;
- Checksum with seed value A;
- Checksum with seed value B;
- Message authentication;

Although MAVLink does not support encryption by default, there are some papers describing various attempts in providing an alternative, secure version of MAVLink.

Data Distribution Service (DDS) protocol is an IoT protocol which operates between layer 4 (Transport) and layer 7 (Application) on the ISO/OSI architecture. It can work both on TCP and UDP. With UAVs, DDS can be used to establish communication between the base station and UAV. While DDS is not UAV specific, it can be used to ensure communication between intelligent devices. It supports AES for confidentiality and asymmetric encryption for key exchange and authenticity.

D2GCS represents a ground control station to UAV communication protocol which provides confidentiality, integrity, mutual authentication, and non-repudiation. It uses encryption algorithms such as ECDH for key exchange and digital certificates for encryption, authentication, and non-repudiation. Its best usage is military communication.

4. UAS COMMUNICATION SECURITY

In order to address modern-day challenges regarding UAV and UAS communications, security is a must. To better understand which of these protocols offers the best security, we will make a short comparison analysis of their characteristics.

	Connection type	**Geolocation**	**Open standard**	**Scalability**	**Overhead**	**Payload Integrity**	**Checksum**	**Security**	**Type of encryption (if supported)**
UranusLink	TCP	GPS	No	No	Small	Yes	Yes	Yes	AES
UAVCAN	UDP	GPS	Yes	No	Small	No	No	Limited	N/A
MAVLink	Mostly UDP	GPS	Yes	Yes	Large	No	Yes	No	N/A
D2GCS	TCP & UDP	GPS	Yes	Yes	Large	Yes	Yes	Yes	Symmetric and Asymmetric algorithms
DDS	TCP & UDP	GPS	Yes	Yes	Large	Yes	Yes	Yes	AES, RSA, ECDSA, DHE, ECDHE

5. QUALITY OF SERVICE IN 5G COMMUNICATION

We can say that 5G technology has reached a sufficiently high level of maturity, considering the variety of multimedia services and applications, as well as the capacity for their development, using dedicated slicing technology for media transport (audio, video, etc.), under the conditions of ensuring real-time data flow. From the perspective of Quality of Service (QoS), there is a set of essential parameters to which we can refer:

- Bandwidth: Ensures sufficient data flow so that the application operates without constraints in the production environment.
- Latency: Ensures minimal delay regarding real-time data flow.
- Jitter: Limits the delay of data packets circulating within the 5G network or within a slice.
- Loss: Restricts packet losses measured over a one-second interval

Considering the SMARTER study, conducted by 3GPP in 2015, whose purpose is to identify the characteristics and functionalities required for 5G technology, we can divide the technology's functionalities into three essential service categories:

- **eMBB** (Enhanced Mobile Broadband): Focused on providing high-speed data services, supporting applications like video streaming, augmented reality, and virtual reality.
- **mMTC** (Massive Machine-Type Communication): Geared towards connecting a massive number of IoT devices, sensors, and machines, enabling efficient communication at scale.
- **uRRLC** (Ultra-Reliable Low-Latency Communication): Designed for critical applications that demand extremely low latency and high reliability, such as industrial automation, remote surgery, and autonomous vehicles.

eMBB Services have the following characteristics:

- Real-time Video Streaming: eMBB services facilitate the transmission of real-time video streams, including alerts, using high-speed internet services.
- IoV (Internet of Vehicles): eMBB is also utilized within the IoV framework, aiming to interconnect autonomous vehicles.
- Transfer Rate Perspective: eMBB supports transfer speeds of 10 – 20 Gbps.
- Reliability for Vehicles: eMBB services are reliable even for vehicles traveling at speeds of up to 500 km/h.
- Aerospace and Unmanned Ground Vehicles: In the context of 5G, this technology plays a crucial role in data streaming while maintaining competitive Quality of Service (QoS).

- Technological Approach for Vehicle Communications: A multilayered stack built using Wi-Fi protocols enables communication between vehicles.

These protocols support various scenarios and can be adapted to vehicular traffic, as it follows:

- **GPSR-2p**: A position-based routing protocol that utilizes the transmission of coordinates in video format (Greedy Perimeter Stateless Routing).
- **VIRTUS**: A protocol that calculates the relative time between two vehicles to proactively estimate their future positions.
- **LIAITHON**: Considered a multipath or a module that identifies multiple routing paths based solely on the current location.

Considering that the network itself defines a perimeter zone, 5G can enable edge computing by allocating resources based on where they are needed. This improves data processing, reduces latency, and enhances response time for vehicles using 5G technology. [19]

7. CONCLUSIONS

Security is an important concern in ensuring UAVs communication throughout network protocols. As limited or no security would leave the door open to attacks such as man-in-the-middle, eavesdropping or identity spoofing, encryption and authentication would protect against these types of attacks. Still, it is still difficult to protect against flooding, DoS attacks jamming, therefore in addition to the security tools that come with the protocol, the physical security of both the UAV and the UAS, as a whole, is required.

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AIR PROTECTION ENCRYPTION PROTOCOLS FOR SECURING AIR TRAFFIC CONTROL COMMUNICATION

Valentin PREDA[*], Răzvan GHICA[*], Iulian BLENDEA[*], Dumitru DIACU[*], Alin GHIȚĂ[*], Andrei-Mihai LUCHIAN[**]

[*]National Polytechnic University of Science and Technology Bucharest, Romania (preda.valix@gmail.com, alexandru.ghica@stsnet.ro, iulian.blendea@stsnet.ro, diacudorin@yahoo.com)
[**]Special Telecommunications Service, Bucharest, Romania (alin.ghita@stsnet.ro, riesigen@gmail.com)

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Abstract: *The article presents a detailed analysis of the encryption protocols used in air traffic control systems to ensure the security of communication between aircraft and ground systems. The importance of secure communication in air traffic management is highlighted and encryption protocols such as AES, RSA and ECC are examined within the specific context of air traffic control. Special emphasis is placed on secure communication architecture and cryptographic key management solutions. Challenges and solutions in implementing these protocols in complex environments with high security requirements are also discussed.*

Keywords*: encryption, security, air traffic control, encryption protocols, AES, RSA, ECC, secure architecture, cryptographic key management, air communications.*

1. INTRODUCTION

Air traffic control systems (ATC - Air Traffic Control) represent an essential infrastructure in the safe and efficient management of air traffic globally. These systems are responsible for monitoring and guiding aircraft in the airspace, ensuring that flights are carried out safely and according to established rules.

The importance of secure communication within air traffic control systems cannot be understated. Accurate and rapid communication between air traffic controllers and pilots is critical to collision prevention and emergency management. In such a dynamic and complex environment, every piece of information transmitted must be protected against interception or modification by unauthorized parties. [1]

The introduction of encryption protocols is a critical component in ensuring the security of air communication. Encryption is the process of transforming data into a format unreadable by those who do not have the appropriate decryption key. Thus, even if messages are intercepted, they remain incomprehensible to attackers. [2]

The statement of the problem comes in the context of the identification of vulnerabilities in air traffic control systems. With increasing interconnectivity and dependence on technology, these systems are becoming increasingly exposed to various cyber threats. Attacks on infrastructure ATCs can have serious consequences, including disrupting air traffic and even endangering the lives of passengers and flight crews. [3]

In this regard, it is imperative to implement robust encryption measures to protect communication and data within air traffic control systems. Strong encryption provides an effective barrier against the interception and manipulation of sensitive information, helping to strengthen aviation security.

2. PRESENTATION OF AIR TRAFFIC CONTROL SYSTEMS

The role of air traffic control is crucial in ensuring safe, efficient and orderly air travel. These systems and procedures are designed to manage the movement of aircraft in airspace, prevent collisions and facilitate the flow of traffic in an organized manner. Through air traffic control, coordination is ensured between aircraft and controllers to maintain safe distance and guide aircraft to their destinations in an efficient manner. [4]

The main components of air traffic control systems include:

Ground-Based Radar: Radar is an essential tool for monitoring and detecting aircraft in airspace. Ground-based radar uses radio emissions to detect and track moving aircraft. This information is transmitted to air traffic control centers, where controllers use this data to guide flights safely.

Communication systems: Communication between controllers and pilots is essential for flight coordination. Communication systems enable the rapid and accurate exchange of information between controllers and flight crews. These systems include dedicated radio frequencies as well as voice and data communication channels. [5]

Aircraft Avionics: Avionics is the set of electronic systems and instruments installed on aircraft for navigation, communication and control. These systems include equipment such as transponders, which transmit information about the identity and position of the aircraft to air traffic controllers, and advanced navigation systems, which help pilots follow planned routes and avoid obstacles during flight. [6]

The functionalities of air traffic control systems include monitoring air traffic, guiding aircraft on safe and efficient trajectories, managing airspace to avoid collisions, and facilitating communication between controllers and pilots. Through these advanced systems and technologies, it is ensured that flights are carried out safely and according to air traffic rules.

3. ENCRYPTION PROTOCOLS FOR AIR TRAFFIC CONTROL SYSTEMS

In air traffic control systems, various encryption protocols are used to ensure the confidentiality and integrity of communications between aircraft and ground systems. These include:

1. AES (Advanced Encryption Standard): AES is one of the most widely used symmetric encryption algorithms today. It is efficient and offers high security. AES is primarily used to encrypt data transmitted between aircraft and air traffic control centers to protect sensitive information.

2. RSA (Rivest–Shamir–Adleman): RSA is an asymmetric encryption algorithm that uses a pair of public and private keys. It is often used for key exchange and authentication in secure communications. In air traffic control, RSA can be used to ensure the confidentiality and authenticity of messages transmitted between aircraft and control centers.

3. ECC (Elliptic Curve Cryptography): ECC is another asymmetric encryption algorithm known for its resource efficiency and the high level of security it provides. In air traffic control systems, ECC can be used to encrypt and authenticate data transmitted between various infrastructure components.

How encryption ensures the confidentiality and integrity of communication:

Encryption is essential to ensure the confidentiality and integrity of communication in air traffic control systems. Through encryption, data transmitted between aircraft and ground systems is transformed into a format unreadable by anyone who does not possess

the appropriate decryption key. Thus, even if the data is intercepted by an attacker, it remains incomprehensible and unusable. [7], [8]

Encryption also ensures data integrity, as any attempt to change the encrypted information can be detected by the recipient who decrypts the message. Additionally, encryption algorithms can be combined with hash functions to verify data integrity.

Criteria for selecting encryption protocols in air traffic control:

In choosing encryption protocols for air traffic control systems, several factors are considered, including:

• Computational efficiency: Encryption protocols should provide a high level of security without compromising systems performance.

• Resistance to cryptographic attacks: Protocols must be resistant to attacks such as cryptanalysis and brute force.

• Compatibility and interoperability: The selected protocols should be compatible with the existing infrastructure and allow efficient communication between the different components of the air traffic control system.

• Updates and standards: It is important that encryption protocols comply with current security standards and are regularly updated to address new threats and vulnerabilities.

Through careful evaluation and selection of encryption protocols, it is ensured that communication in air traffic control systems remains secure and protected against cyber threats. [9]

4. ENCRYPTION PROTOCOLS FOR AIR TRAFFIC CONTROL SYSTEMS

This chapter proposes a secure communication architecture specifically adapted for Air Traffic Management (ATM) systems. The main purpose of this architecture is to provide a robust framework for ensuring the confidentiality, integrity and authenticity of data in communication between aircraft, air traffic control centers and other entities involved in air traffic management.

Layered approach to security:

The proposed architecture is based on a layered approach to security, which integrates multiple levels of protection to ensure a secure communication environment. This includes:

1. Encryption: Use of encryption algorithms such as AES, RSA or ECC to protect data transmitted between the various components of the ATM system. Encryption ensures the confidentiality of information by converting it into a format that is unreadable by anyone who does not have the appropriate decryption key.

2. Digital signatures: Implementation of digital signatures to ensure the integrity of transmitted data and to confirm the authenticity of messages. By using digital signatures, it is guaranteed that the data has not been altered in transit and that it comes from the declared source.

3. Authentication mechanisms: Integrating authentication mechanisms, such as digital certificates or multi-factor authentication protocols, to verify the identity and access rights of communication participants. These mechanisms ensure that only authorized entities can access and communicate within the ATM system. [10]

Effective key management practices: A crucial aspect of the architecture is the management of the cryptographic keys used to encrypt and decrypt data. To ensure system security and reliability, effective key management practices are implemented, including:

• Secure Key Generation: Using secure cryptographic algorithms to generate cryptographic keys so that they are resistant to brute force and cryptanalytic attacks.

• Secure Key Distribution: Implementing secure protocols for key distribution to authorized participants within the ATM system, ensuring that keys are transmitted in a confidential and authentic manner.

• Secure key storage: Using secure key storage mechanisms, such as hardware security modules or key management systems, to prevent unauthorized access to cryptographic keys. [11], [12]

By implementing a secure communication architecture based on these principles and practices, air traffic management systems can ensure a secure communication environment protected against cyber threats and information security risks.

5. SECURE COMMUNICATION ARCHITECTURE FOR AIR TRAFFIC MANAGEMENT SYSTEMS

Proposal of a Secure Communication Architecture Adapted for Air Traffic Management Systems:

The proposed architecture for Air Traffic Management (ATM) systems is built upon robust cybersecurity principles, with the primary objective of ensuring the confidentiality, integrity, and authenticity of communications within these critical systems. The architecture is designed to efficiently manage communication among various entities involved in air traffic control, including air traffic controllers, aircraft, and other components of the ATM infrastructure.

Layered Security Approach:

The architecture is based on a layered security approach, integrating multiple levels of protection to ensure a secure communication environment. This approach includes:

Encryption: Utilizing strong encryption algorithms such as AES, RSA, or ECC to encrypt data transmitted between various components of the ATM system. Encryption ensures data confidentiality, protecting them against interception and unauthorized access.

Digital Signatures: Implementing digital signatures to guarantee data integrity and message authenticity. Digital signatures are used to verify that the data has not been altered in transit and that it originates from the declared source.

Authentication Mechanisms: Integrating robust authentication mechanisms, such as digital certificates or multi-factor authentication protocols, to verify the identity and access rights of communication participants. These mechanisms ensure that only authorized entities can access

Efficient Key Management Practices:

• A crucial aspect of the architecture is the efficient management of cryptographic keys used for data encryption and decryption. To ensure the security and reliability of the system, efficient key management practices are implemented, including:

• Secure Key Generation: Using secure cryptographic algorithms for generating cryptographic keys, ensuring they are resistant to brute-force and cryptanalytic attacks.

• Secure Key Distribution: Implementing secure protocols for distributing keys to authorized participants within the ATM system, ensuring that keys are transmitted in a confidential and authentic manner.

• Secure Key Storage: Utilizing mechanisms for secure key storage, such as hardware security modules or key management systems, to prevent unauthorized access to cryptographic keys.

• By implementing this secure communication architecture, air traffic management systems can ensure a secure and protected communication environment against cyber threats and information security risks.

6. COMMUNICATION SECURITY IN DRONE OPERATIONS

Communication in drone operations is a crucial aspect for the functioning and control of these unmanned aerial vehicles. Beyond the benefits offered by drones in various fields, including military, surveillance, or civilian applications such as deliveries or imaging capture, ensuring communication security is essential for preventing unauthorized access, interception, or manipulation of transmitted data, and for avoiding potential incidents.

Vulnerabilities in Drone Communications

1. Unauthorized interception: Due to the wireless nature of communications, there is a risk that an attacker could intercept and eavesdrop on communications between the drone and its control station or between the drone and other connected devices. This interception could lead to the exposure of sensitive information or compromise of operations.

2. Jamming attacks: Jamming attacks involve disrupting or blocking the communication signal between the drone and its controller. These attacks can be carried out using specialized devices that emit strong radio signals, resulting in loss of control over the drone and potential incidents.

3. Data manipulation: Another risk is the possibility of an attacker manipulating the data transmitted between the drone and its controller. Through "man-in-the-middle" attacks, an attacker can modify or falsify transmitted data, misleading the drone operator and compromising operations.

Security Measures for Drone Communications

1. Encryption of Communications: Using strong encryption protocols to protect the data transmitted between the drone and its controller. Encryption ensures the confidentiality of information and protects against interception and unauthorized access.

2. Authentication and Authorization: Implementing robust authentication and authorization mechanisms to verify the identity and access rights of the parties involved in drone communications. These mechanisms help prevent unauthorized access and data manipulation.

3. Frequency and Channel Diversification: Utilizing technologies that allow for the diversification of frequencies and communication channels to reduce the risk of interference and jamming attacks.

4. Continuous Monitoring and Anomaly Detection: Implementing continuous monitoring and anomaly detection systems to quickly identify and counteract any attempted attacks or suspicious behavior in drone communications.

By adopting these security measures and implementing appropriate protocols and technologies, a high level of security can be ensured in drone communications, contributing to the protection of information and the prevention of potential incidents or cyber attacks.

7. CASE STUDIES OR EXAMPLES

Successful implementations of encryption protocols in securing communications within drone operations are essential for protecting sensitive data and operational information transmitted between operators and drones. Encryption is used to ensure confidentiality, integrity, and authentication of data during drone operations, helping to mitigate security risks and improve the resilience of aerial communication networks.

An illustrative example of the successful implementation of encryption protocols in drone operations is their use in military, security, and surveillance applications. In these

scenarios, drones are often used for collecting and transmitting sensitive data, such as images and videos from strategic locations or events of interest.

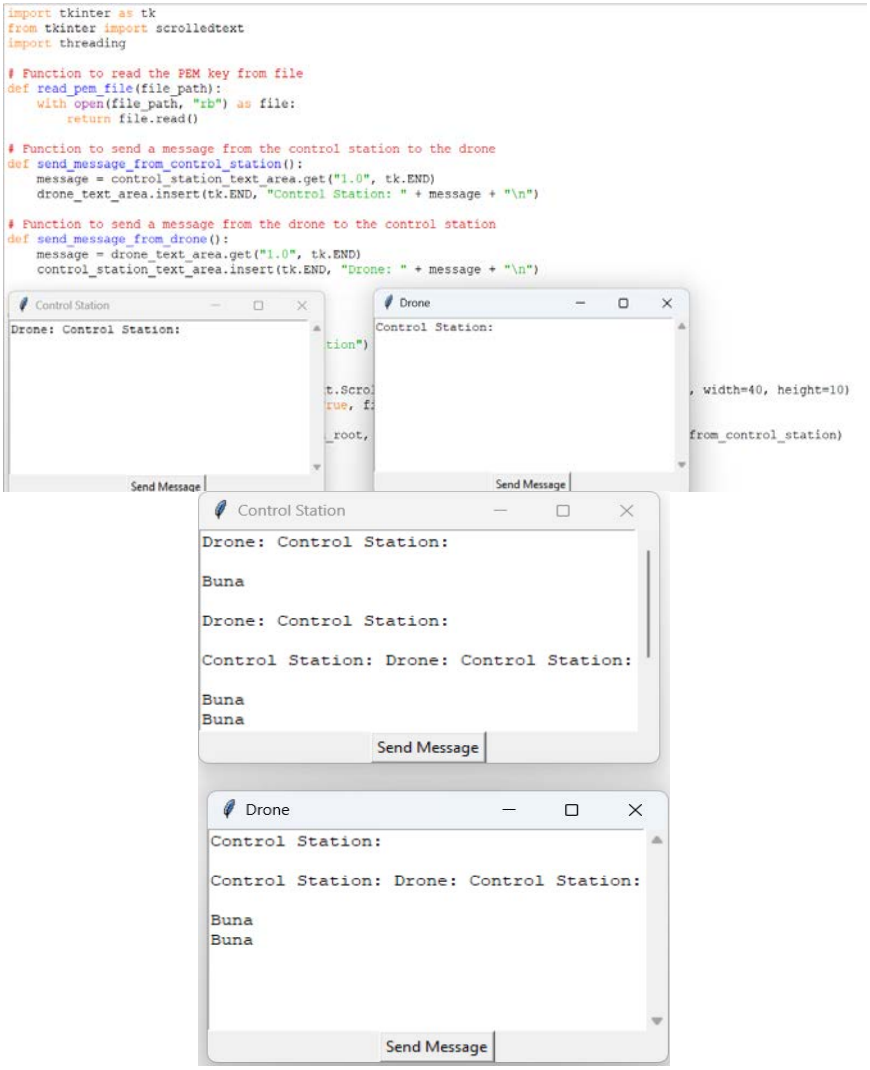
The effectiveness of encryption in reducing security risks and improving the resilience of aerial communication networks in drone operations can be highlighted through:

1. Confidentiality: Encrypting data transmitted between operators and drones ensures that sensitive information, such as images and videos from sensitive locations, cannot be intercepted or accessed by unauthorized third parties.

2. Encryption protocols enable mutual authentication between operators and drones, confirming the identity of each party involved in communication and preventing any attempt at impersonation or unauthorized access to drone systems.

3. Resilience to Cyber Attacks: Encrypting data during drone operations helps protect against potential cyber threats, such as communication interception, ransomware attacks, or other attacks on the integrity and security of systems.

- **Python Application for Encrypted Communication between Control Station and Drone Using PEM.**



In conclusion, implementing encryption protocols in securing communications within drone operations is essential Authentication for ensuring the protection of sensitive data and information, contributing to the reduction of security risks and the improvement of the resilience of aerial communication networks.

Python Code for Generating PEM Using an RSA Private Key

```
from cryptography.hazmat.primitives import serialization
from cryptography.hazmat.primitives.asymmetric import rsa
from cryptography.hazmat.backends import default_backend
# Generăm o cheie privată RSA
private_key=rsa.generate_private_key(public_exponent=65537,key_size=2048,
backend=default_backend())
# Salvăm cheia privată în format PEM
pem = private_key.private_bytes(encoding=serialization.Encoding.PEM,format=
serialization.PrivateFormat.PKCS8,encryption_algorithm=serialization.NoEncryption())
# Scriem cheia privată într-un fișier PEM
with open("control_station_private_key.pem", "wb") as pem_out:
    pem_out.write(pem)
print("Cheia privată a stației de control a fost generată și salvată în fișierul
'control_station_private_key.pem'")
```

Python Code for Reading PEM

```
<cryptography.hazmat.bindings._rust.openssl.rsa.RSAPrivateKey object at 0x000002
9D3F511E50>
from cryptography.hazmat.primitives import serialization
from cryptography.hazmat.primitives.asymmetric import rsa
from cryptography.hazmat.backends import default_backend
# Se deschide fișierul cheii private în modul citire binară
with open("C:/Users/Andrei/Desktop/Articole Revista nr. 2, revista academiei
2023/control_station_private_key.pem", "rb") as key_file:
 # Se încarcă cheia privată  control_station_private_key =
erialization.load_pem_private_key(
 key_file.read(),
 password=None,  # Dacă cheia este protejată cu o parolă, introduceți parola aici
 backend=default_backend()  )
# Afișăm cheia privată încărcată
print(control_station_private_key)
```

8. CONCLUSIONS

In conclusion, the implementation of encryption protocols in securing communications within drone operations is an essential necessity for ensuring the integrity, confidentiality, and authenticity of information transmitted between drones and control stations. Through the analysis and development of appropriate cryptographic solutions, the following aspects have been highlighted:

1. Protection of Sensitive Data: Efficient encryption of aerial communications with drones provides robust protection against interception and unauthorized access to transmitted data, including flight coordinates, captured images and videos, as well as other relevant operational information.

2. Reduction of Security Risks: Implementing encryption protocols significantly contributes to reducing security risks associated with cyber threats, ensuring that transmitted data is protected against attacks and unauthorized access.

3. Improvement of Resilience of Aerial Communication Networks: Encrypting communications between drones and control stations enhances the resilience of aerial communication networks, increasing their capacity to withstand cyber attacks and other security threats.

4. Standardization and Proper Implementation: It is essential to adopt security standards and properly implement encryption protocols within drone operations, ensuring compliance with the highest standards of security and data protection.

5. Continued Development of Cryptographic Technology: As cyber threats evolve constantly, it is crucial to continue the development and innovation of cryptographic technology to address future challenges and ensure the security of drone communications against increasingly sophisticated adversaries.

In conclusion, by implementing encryption protocols and adopting robust security practices, the drone operations industry can advance towards increased security and more effective protection of sensitive data, contributing to strengthening trust in the use of these technologies in a growing range of applications.

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RESEARCH ON THE INFLUENCE OF SECONDARY HEAT TREATMENT PARAMETERS ON THE MARTENSITIC STAINLESS STEEL PROPERTIES

Maria STOICANESCU

"Transilvania" University of Brasov, Romania (stoican.m@unitbv.ro)

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Abstract: *Heat treatments constitute an essential stage for the possibilities of improving the mechanical properties of metal materials, such as hardness, mechanical strength and corrosion resistance.*

Any change in the heat treatment parameters, such as temperature, holding time and cooling rate, can influence the structure of the steel and cause the formation of the martensitic phase, responsible for increasing the hardness. Moreover, if the temperature and time are correctly selected, they can help eliminate internal stresses and imperfections in the crystalline structure, thus improving the strength and ductility of the steel.

The hardness of martensitic stainless steel needs to be increased to meet the performance requirements for the applications in which it is used, such as the manufacture of knives, surgical instruments or components for the aerospace industry. Martensitic stainless steel is valued for its corrosion resistance and relatively low cost, and the hardness increase is essential to ensure proper operation and durability of products manufactured from this material.

Any change in the martensitic stainless steel heat treatment parameters has a significant impact on increasing the hardness and improving its mechanical properties, being essential for obtaining the desired performance in various industrial applications.

Keywords: *mechanical properties, heat treatment parameters, martensitic stainless steel*

1. INTRODUCTION

Stainless steels are metal alloys containing iron, chromium, nickel and other elements with chemical properties which make them resistant to corrosion and oxidation. These materials are durable and versatile, and they are used in a variety of industrial and commercial applications. In addition to corrosion resistance, stainless steels are also resistant to high temperatures and pressure, being thus ideal for use in aggressive environments. They can be processed into different shapes and sizes, giving them great flexibility in terms of their use in various applications [1, 5, 4]

Due to these properties, stainless steels are frequently used in the chemical, food, pharmaceutical, material processing and construction industries. They are also used in interior and exterior design, in the manufacture of kitchen tools and utensils, as well as in the construction of vessels and aircrafts.

Heat treatments give martensitic stainless steel excellent mechanical and chemical properties, such as high hardness, corrosion resistance and wear resistance [5].

Martensitic stainless steels are known for their high hardness, which is achieved using tempering heat treatments. A high hardness gives these materials an increased resistance to wear and cutting [3].

The good corrosion resistance specific to these alloys is due to the content of chromium and other alloying elements, forming a passive oxide layer on the surface. However, martensitic stainless steels are more susceptible to stress corrosion than other types of stainless steels due to their higher carbon content. Therefore, it is important that they are heat treated correctly to minimize this vulnerability [2, 5].

The results of different heat treatments may vary depending on parameters such as temperature, exposure time and the environment in which the treatment is performed. The interpretation of these results is crucial for understanding how material properties change depending on the treatment.

Temperature and exposure time can influence the degree of transformation of the material phase or the size and distribution of particles in the material. Moreover, the environment in which the heat treatment is performed can affect the chemical reactions taking place in the materials [1].

The heat treatment results must be interpreted taking into account these variables and providing detailed information on how they influence material properties. For example, an increase in hardness after a heat treatment may indicate an increase in internal stresses in the material or a change in the crystalline structure.

2. EXPERIMENTAL RESEARCH

The material used in the study is the martensitic stainless steel AISI 420, EN 1.4021, and its chemical composition is presented in Table 1.

Table 1. Chemical composition of the AISI 420 steel

C	Si	Mn	P	S	Cr
0.16 - 0.25	max 1	max 1.5	max 0.04	max 0,015	12 - 14

The material thus selected was cut and subjected to several heat treatment variants in order to analyse its properties (the hardness).

The parameters which were modified in the heat treatments were the tempering holding time and temperature, as follows:

- Sample 1, the material was annealed at 850 °C - initial state
- Sample 2 was heated to 1100 °C for 30 minutes and cooled in water.
- Sample 3 was heated to 1100 °C for 30 minutes and cooled in water, followed by tempering at 400 °C for 30 minutes and cooling in air.
- Sample 4 was heated to 1100 °C for 30 minutes and cooled in water, followed by tempering at 400 °C for one hour and cooling in air.
- Sample 5 was heated to 1100 °C for 30 minutes and cooled in water, followed by tempering at 500 °C for 30 minutes and cooling in air.
- Sample 6 was heated to 1100 °C for 30 minutes and cooled in water, followed by tempering at 500 °C for one hour and cooling in air.
- Sample 7 was heated to 1100 °C for 30 minutes and cooled in air.

Figures 1 - 7 show the structures obtained following the heat treatment applied.

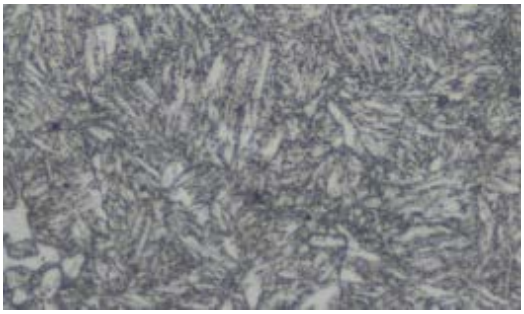

FIG. 1. Sample 1 - initial state. Aqua regia etching. 500:1

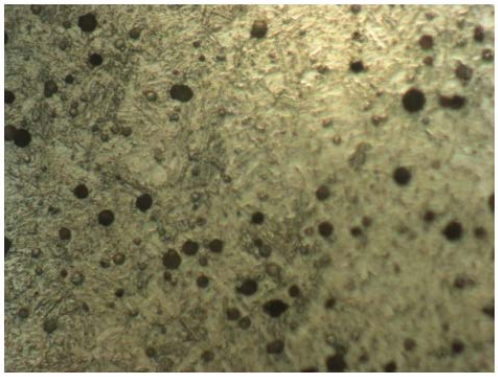

FIG. 2. Sample 2 - heating to 1100 °C for 30 minutes and cooling in water. Aqua regia etching, 500:1

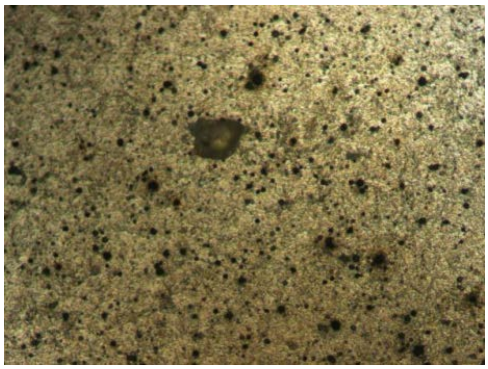

FIG. 3. Sample 3 - heating to 1100 °C for 30 minutes and cooling in water, followed by tempering at 400 °C for 30 minutes and cooling in air. Aqua regia etching. 500:1

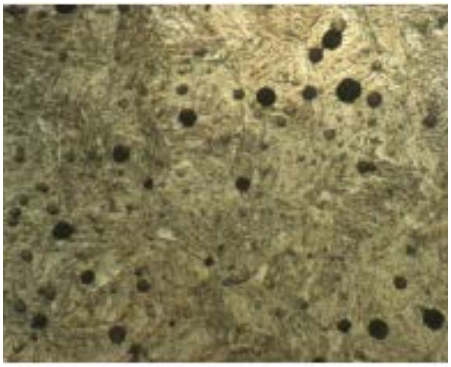

FIG. 4. Sample 4 - heating to 1100 °C for 30 minutes and cooling in water, followed by tempering at 400 °C for 1 hour and cooling in air. Aqua regia etching. 500:1

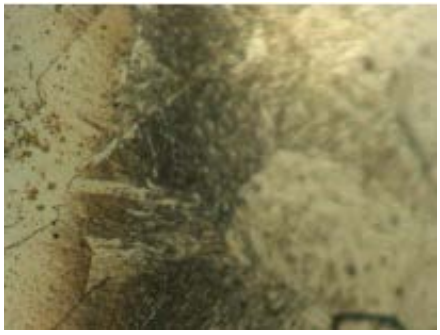

FIG. 5. Sample 5 - heating to 1100 °C for 30 minutes and cooling in water, followed by tempering at 500 °C for 30 minutes and cooling in air. Aqua regia etching. 500:1

FIG. 6. Sample 6 - heating to 1100°C for 30 minutes and cooling in water, followed by tempering at 500°C for one hour and cooling in air. Aqua regia etching. 500:1

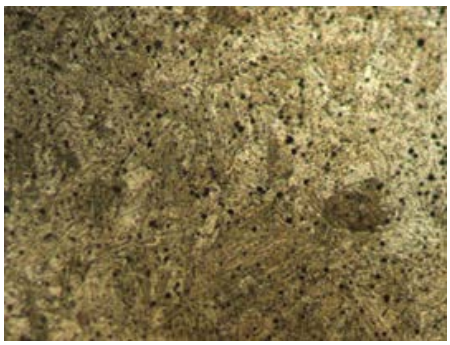

FIG. 7. - Sample 7 - heating to 1100 °C for 30 minutes and cooling in air. Aqua regia etching. 500:1

Table 2 shows the hardness values obtained after the different heat treatment procedures applied.

Table 2. The hardness values obtained following the heat treatments applied

Sample no.	Hardness values	
	Average [HV]	Average [HRC]
1	256	23.5
2	381.3	38.73
3	342.9	34.73
4	631.23	50.06
5	430.56	42.9
6	431.36	43.7
7	415.16	42.1

Steels with 12...13% Cr feature high resistance to tempering and do not soften at tempering temperatures up to 500°C, and those with average carbon (0.2...0.3% C) even give a secondary hardening effect around 500°C.

The (Fe, Cr)3 C carbide transforms into the (Fe, Cr)7 C3 dispersed and coherent carbide; the subsequent increase in temperature leads to the transformation into (Fe, Cr)23 C6 carbide and to rapid coalescence at tempering temperatures above 600°C.

In the case of the analysed steel, having regard to the fact that it is a low carbon content steel, the amount of carbides obtained - as it appears from the analysed structures - is also reduced. The heating to the tempering temperature of 1100°C led to the almost complete dissolution of the carbides. After tempering, there can be noted the occurrence of fine precipitates and of the bainitic appearance in the microstructure.

CONCLUSIONS

Heat treatments are essential to improve the properties of martensitic stainless steels, such as corrosion resistance and wear resistance.

The hardness and tensile strength of martensitic stainless steels can be improved by applying the correct heat treatment.

The crystalline structure of martensitic stainless steels can be improved by controlled heat treatments, which can help increase the hardness and strength of the materials.

The martensitic stainless steel properties can be improved by heat treatment by appropriately selecting the heat treatment parameters, such as temperature, cooling time and rate.

The maximum hardness values were obtained for the treatment in which a tempering the 400 °C for one hour was applied after quenching.

The increase of the holding time from 30 minutes to one hour for the tempering at 400°C for 30 minutes led to a significant increase in hardness.

The increase of the tempering temperature to 500°C led to a decrease in hardness regardless of the holding time.

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THE IMPORTANCE OF THE LEADER'S PASSION AND POISE IN THE DEVELOPMENT OF LEADERSHIP

Daniela BELU

"Henri Coandă" Air Force Academy, Braşov, Romania (daniela.belu@afahc.ro)

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Abstract: *The study tackles the issue of the essential behaviours that directly affect the impression that a leader leaves upon the others. Passion and poise are the most explicit forms of manifestation of leadership and, at the same time, the chance to be efficient in having successful interactions between the leaders and other people.*

Keywords: *leader / leadership / charisma / passion / poise*

1. THE ROLE OF PASSION IN LEADERSHIP

Leaders are passionate about what they do. They impress others trough their joy and the enthusiasm with which they get actively involved in everything that matters to them. Their passion not only refers to their profession and their family, but it also concerns less ardent daily matters, which is why they get to be admired by the people in their entourage and they become a source of inspiration for those who are influenced by their emotions, way of thinking, manner of communication and magnetism.

The leader's passionate way of communicating (J.P. Kotter, What leaders really do, 2001) is characterized by:

- a particular persistence in transmitting a message very energetically, by replacing the preoccupation for the preparation of the manner of communication with the authentic strife to share one's own beliefs and opinions with the audience in the best possible way;
- a joyful acceptance of the fact that it is a normal thing not to be taken on faith and that the audience might have their own opinions in contesting any belief, the dialogue thus becoming interesting to the extent to which one postpones the instantaneous attaining of the goal to convince while using their passion only as a starting point for communicating their opinions and tenaciously arguing for any counterargument;
- the satisfaction of not having to make any compromise because one knows what one wants and is capable of stimulating the others with their enthusiasm.

People will perceive passionate communicators as people who are capable of leadership, in other words as leaders, or individuals who are ready to take on any challenge, who have a purpose, who are authentic, full-hearted, self-asserted, energetic, soulful, cheerful and with a sense of humour. The effect of leadership finally resides in the magnetic force that determines the influencing of one's peers through contagion/mirroring. This so-called mirroring phenomenon exists because leaders like to talk about what preoccupies them and they love what they do, this being the reason why

they manage to generate an entirely new approach whenever they get involved, making a very powerful positive impression upon the audience.

The effect of the leaders' enthusiasm is all the more contagious as they are less preoccupied with their person, uninhibited in sharing what really is most important to them, leaving little space for uncertainty and that is also their specific manner of consolidating self-confidence. Leaders act openly, spontaneously and that makes it highly probable for them to create an atmosphere in which people are treated respectfully, in an equal and honest manner. The leaders' spontaneity comes from the fact that they dare to stay connected to what they are most passionate about, which allows them to access their internal resources without any restrictions, by way of:

- anticipation (training oneself for challenging situations that require action without a guiding map, such as speaking one's mind freely, without a pre-set narrative);
- listening (collecting information and clues related to what other people think and feel by listening empathetically and watching carefully, to be able to answer whenever it is required);
- overall thinking (the effort to expand thinking by changing the perspective from which one approaches topics of discussion, either by focusing on their essence, or by focusing on what the current approach might really be lacking, or by starting from what the topic of discussion might remind one of, or by starting from how it relates to one's personal experiences or what the current context brings to the topic etc.);
- gaining time to think (listening patiently and waiting for the interlocutors to finish what they have to say, before asking questions, taking time to think when lacking an answer to an open-ended question, returning to what the interlocutor said to ask for further explanations, telling a story related to the issue in question in order to postpone an answer).

The leaders' power of engagement makes them question conventional approaches, express strong opinions, claim facts and not words, and show an uncomfortable willingness to change radically. Their passion makes them have the courage to raise uncomfortable issues or to question what is happening and, behind these manifestations, they, the leaders, may paradoxically be anxious or insecure about themselves. The more passionate the leaders are, the more uninhibited they are, risking, to a greater extent, to lose their temper, as well as their integrity, depending on the correctness of their choice of challenges; however, in the positive register, the need to be defensive is excluded, out of lack of confidence or the desire to paint someone else black.

2. THE IMPORTANCE OF POISE IN LEADERSHIP

Poise is the attitude of caring about one's image in general, with a view to revealing the best version of oneself to those around. Even though a person's inner self matters more than their exterior appearance, first impressions are still important when people interact with their peers, since the general appearance can be very important in intuiting whether a person is elegant, sober, conventional, balanced, bold, optimistic, conscientious, meticulous, creative, relaxed or, on the contrary, original, depressed, pessimistic, shy, disorganised, inattentive, unimaginative, tense and rigid. Such prejudices can occur in a matter of seconds, which is why poise is very important.

People tend to make assumptions about other people:

- Economic status (wealthy, poor, of average station, successful);
- Level of education (academic, average education, incomplete education);
- Credibility (honest, trustworthy, dependable);

- Social status (high, successful, well-integrated, lonely, declining, growing);
- Relationship (attractive, confident, anxious, relaxed);
- Attitude (aggressive, friendly, unpretentious, hard to get to know).

To improve one's impact is to invest time and resources in order to develop various aspects of one's appearance in general, which could include one's apparel, stance, care, handshake, manners, image, etc. (J. Kotterman, Leadership vs. Management: What's the difference? 2006).

Apparel is the most obvious area in which rapid changes can be made and to ignore the power of clothes is a form of arrogance or a sign that one has lost the sense of reality. Some of the most common mistakes that people make when it comes to clothing are the following:

- choosing cheap and cheerful-looking clothes
- ignoring the classical outfit in order to be trendy
- disregarding what is most suitable for one
- not matching colours
- excessive use of accessories
- wearing dowdy clothes:
    - worn cuffs/collars,
    - poorly ironed clothes,
    - stains on the ties, suits, dresses, etc.,
    - missing or unbuttoned buttons,
    - too long or too short sleeves or trousers,
    - old, dirty or torn shoes,
    - ragged belts, bags,
- being ostentatiously well-dressed.

Manners remain an important factor that influence the presence of leaders, and their powerful poise is due to the fact that they approach other people without treating them differently, being equally polite and adapted to the context both with people they admire and with those they consider unimportant. What matters in the case of good manners is that when they are adapted to the context, they represent an indication of a person showing the same respect to everyone around and they help avoid blunders such as:

- not thanking those who have shown kindness;
- swinging forward and backward in one's chair;
- being openly familiar towards someone without their permission;
- not treating people around with respect;
- touching objects and people without being invited to do so;
- interrupting other people repeatedly or making noises constantly;
- insulting someone privately or publicly.

3. THE P-BY-A TECHNIQUE

The Purpose – Be Yourself – Attractiveness Model (Andrew Leigh, Charisma, 2010) considers charismatic effect to be a useful tool in the development of leadership, following the constant progress in becoming aware of what generates a good and lasting impression, starting from a gentle approach of three basic elements:

- the PURPOSE of your communication;
- BEING YOURSELF, through fluency, self-confidence, mindfulness, authenticity, courage, passion and poise;
- being a pleasant person (ATTRACTIVENESS), by capturing the interlocutor's attention, by interdependence and by establishing personal relations.

Two possible strategies can be adopted when using the P-BY-A technique:

- focusing on the known strengths and improving them;
- tackling weaknesses in order to work with them and to achieve personal development.

There are usually certain combinations of the two strategies that work best, particularly when a four-step approach is used:

1. preparing communications based on the three steps: the reason why one communicates, remaining authentic, capturing the attention of the audience;
2. selecting one of the areas of development that one wishes to perfect: trust, passion, building a relationship, catching the attention, etc.;
3. experimenting with the new modes of interaction, such as the use of open-ended questions, careful listening, the avoidance of self-victimization language;
4. reviewing the results and thinking about the actions that should be taken.

One should avoid haste and should try to clarify various issues piece by piece, but one should work continuously, without leaving any gaps between the different experiences in daily interactions, always being aware of what is happening, of the effect one has on the audience, of how the audience seems to think, feel or behave and review the dynamics of one's relationship with the group on a case-by-case basis. One should avoid setting unrealistic goals because they will soon be abandoned anyway, for they do not rely on the resources that are actually available. Instead, one should move forward step by step, constantly experimenting, to review things along the way, starting from the things that have improved. In this endeavour, true leaders have a strong spontaneous impact, being unaware that they are in fact applying the P-BY-A technique, which works for them automatically, as it is rooted in their way of relating to the people around them.

The creation of a leadership development plan should include the training of one's poise by applying alternative ways of working on a weekly basis, which will be carried out in rotation. In the first week, one should focus on the purpose of the communication, in the second on improving the ability to be authentic by practicing the ways of being oneself and in the third week, one should dedicate oneself to the awareness and practice of the means of capturing the attention of the audience.

4. CONCLUSION: THE PRESENTATIONS AND SESSIONS FROM THE PERSPECTIVE OF THE P-BY-A TECHNIQUE

In conclusion, the optimized improvement of the charismatic effect is one of the stages of leadership training, in which it is advisable to apply the P-BY-A technique, through awareness, with the help of some algorithms consisting of:

- some sets of open-ended questions about the intended purpose,
- questions about what it means to be oneself,
- questions about how to make oneself liked by the audience.

For example:

- What exactly do you want to accomplish?
- How exactly will you know that you've accomplished what you set out to do?
- Can you express the intended purpose in a slogan?
- Who are you?
- How do you want the people around you to perceive you?
- What could prevent you from being yourself?
- How could you overcome obstacles in being yourself?
- What was your path to success this time?
- What is there to learn for next time?

- lapidary formulas expressing topical political/ economic/ personal/ ethnical/ organisational goals/issues in a full/convincing manner.

For example:

- ”I treat the tasks in the job description as if it were a surprise party for myself"
- "I look for opportunities to actively promote the achieved results ".
- "I live every day as if it were my last."
- "I accept and build arguments, based on what the interlocutor claims."
- "I listen empathetically to the interlocutor and find out what is not explicitly said."

PRESENTATIONS can be optimized from the perspective of the P-BY-A technique, by applying a 4-stage strategy as follows:

1. The **preparation** must start with the author's strengths and main goal, i.e. what he/she wants the audience to remember from the information presented. His/her slogan should be: "Speak clearly about achievable and necessary things, which will be analysed piece by piece so that they can be explained one by one, finally clarifying the effectiveness of the process through a dialogue with the audience". At this stage, it is also important that the author of the presentation finds out what might make him/her succeed in terms of the goal he/she has set for him/herself and how he/she might overcome any potential obstacles in expressing the opinions and information to be brought to the attention of the audience.
2. The selection of the behaviours of the person giving a presentation will be made so that he/she remains spontaneous. He/she may be him/herself insofar as he/she chooses to focus, for example, either on his/her own presence/personal attire, or on the authenticity of the presented opinions, or his/her eruditeness, or on the commitment to support his/her views, or his/her passion for the field in question, or his/her self-confidence arising from the experience in the field.
3. Experimentation is the very time interval of the trial by fire, when the author gives his/her presentation, taking the test of assuming the risk of his/her possible inability to influence/capture the attention of the audience, this being the only way to gain experience and self-confidence by learning from the joy of success and the bitterness of failure in an equal manner.
4. The review is the time spent by the person delivering the presentation to review what has worked out fine and what has not, thus completing the experiments he/she had intended to conduct, drawing conclusions about how these experiments have contributed to his/her evolution and what he/she has to learn in order to improve his/her impact.

The SESSIONS may be optimized from the perspective of the P-BY-A technique by also applying a 4-stage strategy as follows:

1. The **preparation** must start with the passion of the organisers' team for the preparation of the materials of the meeting and should pursue the main goal of any meeting, i.e. making the participants really listen to their suggestions, laying the basis for a constructive dialogue and collecting any useful information in relation thereof. The organisers' slogan should be: "Speak clearly about things that are achievable and necessary in the near future, that will inform, inspire and mobilise the audience, thus laying the basis for a constructive dialogue and creating the opportunity for the collection of valuable new ideas/opinions about the topic and more". At this stage, it is also important for the organisers to find out what they could do to achieve the goal of the meeting and how they might overcome the potential obstacles.

2. The **selection** is the time interval of the meeting, in which the organisers will promote a relaxed climate by supporting only those behaviours of the participants

that generate a relaxed atmosphere, requiring them to only focus on the goal of the meeting and on trying to capture the attention of the participants through video presentations on the proposed topic, stopping the perorations outside the topic of the meeting and encouraging those speeches that give rise to valuable feedback. The members of the organising team will avoid dissipating their effort by trying to impress the audience through the charismatic effect they might create by simultaneously displaying two or three of the required behaviours (fluency, self-confidence, appearance, authenticity, courage, passion and poise).

3. **Experimentation** is the stage in which the organisers of the meeting take the risk of using an approach they have never tried before, using new moods to make the participants approach the meeting as a positive event. If, for example, they choose to focus on a type of behaviour such as fluency, then they will focus on the most important ideas, limiting the possibility of getting lost in the details.
4. The **review** is the stage in which the organisers of the meeting will spend time reviewing what has worked and what has not worked at the meetings held during a certain period of time, completing the chosen experiments by drawing conclusions about their impact on the participants based on the participants' reactions, in order to make a connection with future actions that should be taken.

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PROMOTING THE MILITARY PROFESSION, FUNDAMENTAL FACTOR IN HUMAN RESOURCE RECRUITMENT FOR THE ROMANIAN AIR FORCE

Cristian MANOLACHI[*], Florian RĂPAN[**]

[*]Personal Service and Mobilization at the Air Force General Staff, Romania
[**]"Dimitrie Cantemir" Christian University, Bucharest, Romania

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Abstract: *For the Romanian Air Force, the promotion of the military profession, recruitment, selection, initial training, as well as the training of aeronautical personnel represents the most complex and laborious activity, since reaching the operational level requires going through the algorithm of a process that is characterized by a relatively long duration of training, impressive costs and, last but not least, risks specific to the aeronautical environment.*

The trajectory of this process has as its starting point the recruitment and selection of candidates for admission to the higher and post-secondary military institutions of the Air Force, specialized in the training of specialists in military aeronautics. The final point of this path is the combat unit, where the training of the aeronautical personnel takes the form of specialization for the technique served and the achievement of the performance indices that give it the status of operational aeronautical personnel.

The finality of this process is realized in the achievement of the fundamental objective for the Romanian Air Force - the provision of large units and air units with well-trained aeronautical personnel, capable of performing the entire range of aeronautical activities, which can only be achieved through the quality of staged training formative-instructive algorithm.

Keywords*: Air Force, human resource, military profession, promoting, educational offer, promoting campaign for the military profession, recruiting, secelection.*

1. INTRODUCTION

It is unanimously recognized that the human resource is the most important resource in the economy of any organization, even the military institution, and its attraction is a complex, laborious process, with strategic valences for the organization, which requires the allocation of resources, but also specialized personnel in the promotion and recruitment process.

„What is an organization without its employees? It is nothing in the absence of human resources, possibly a lot of expensive equipment"[11]

Therefore, the human resource is unique but, at the same time, the human resource is unpredictable, uncertain, risky. In a word: imperfect.

In the organizational culture, it is considered that human resources are the first strategic resources of an organization, being regarded as one of its most important values, and among the strategic objectives of the organization is also that of attracting the necessary human resources, both to ensure its operation as well as its development.

In this context, human resources management has a decisive role in the process of attracting quality human resources, which can contribute to increasing competitiveness

and ensuring a stable future for the organization, as well as for harmonizing the interests of individuals with its objectives.

The causes of this constant and accelerated reduction of the selection base are multiple, and the factors that influence their appearance or development are mainly external to the military system, difficult to anticipate and almost impossible to control. As an example, the increase in the offers of other employers on the labor market, often tempting and accessible and in line with the aspirations of young generations, can no longer be compensated by a corresponding increase in the benefits granted to young people by the military system, so that, they very easily turn to other fields (careers), which do not involve great personal sacrifices, prohibitions and major incompatibilities like those specific to the military system, without the existence of appropriate compensation measures.

Analyzing the constant downward trend in the number of candidates for the military educational institutions of the Air Force, respectively the "Henri Coandă" Air Force Academy and the "Traian Vuia" Air Force Military Warrant and Non-Commissioned Officer Military School, more significant for the latter , especially since 2016, when the number of candidates who reached the exam phase was sub-unit compared to the years 1990-2000, when the number of candidates was 5-7 per place open to competition, with some variations, the decision was made that the promotion the military profession and the educational offer of the Air Force to constitute one of the priority objectives for the management of human resources in the Air Force.

The activity of promoting the military profession is therefore a basic element of the recruitment of human resources, has strategic valences and is part of the general effort to ensure a constant and sufficient flow of candidates with an appropriate aptitude-motivational profile for the military education institutions of the Air Force Romanians, the "Henri Coandă" Air Force Academy and the "Traian Vuia" Military School of Military Majors and Non-Commissioned Officers of the Air Force.

2. THE MILITARY PROFESSION – SOCIAL VALUE

Being a soldier is a way of life, in which rigorous spirit, dynamic temperament, capacity for sacrifice, passion, strength of character, harmonious physical development and capacity for effort are intertwined. The military profession does not only mean military maneuvers, exercises and training.

There are a multitude of military specialties that require numerous skills, beyond those specific to combatants. Many of them have equivalents in civilian life and ensure the transfer of skills from and to other occupations.

A successful military career begins in an environment of discipline, military values and norms. Young people who embrace the military career must be characterized by will, determination, competitiveness, effective and affective engagement, intellectual curiosity and a desire to work in a team.

The military profession is a vocation and must be done out of passion. Determination, involvement, the courage to support your ideas will lead to success in your military career.

Military personnel frequently move to where their professional skills are needed, in the country or abroad. Mobility is one of the characteristics of this profession.

However, professional soldiers have, in addition to responsibilities, rights that they benefit from. In addition to a guaranteed income, which increases according to career development, military personnel have the right to free equipment, monthly compensation for food, the right to service housing or a monthly amount for rent, the right to medicines

and medical assistance, to holidays and permits, to rest facilities and recovery of work capacity, to compensate the expenses of travel to the family when they carry out their activity in other localities than the ones where they live. There are also other rights, compensations or facilities that the military can benefit from, depending on the professional and social situation of each one[18].

2.1 Promoting the military profession. General context

A particularly important event for our country and, implicitly, for the Romanian Army, was the signing, on April 4, 2004, of the accession treaty to the North Atlantic Alliance, Romania becoming a full member after the ratification of the treaty by The Romanian Parliament.

The North Atlantic Treaty Organization (N.A.T.O.) [19] is a political-military alliance made up of 31 states from Europe and North America that have adhered to its values. The essential purpose of N.A.T.O. is to ensure the freedom and security of all its members through political and military means, in accordance with the provisions of *the North Atlantic Treaty* and the principles of the United Nations Charter. *The North Atlantic Treaty* was signed on April 4, 1949 in Washington DC, represents the legal and contractual basis of the Alliance and was established based on Article 51 of the United Nations Charter, which affirms the inalienable right of independent states to individual or collective defense.

After Romania's full accession to N.A.T.O., the Romanian Army was subjected to a complex and long process of transformation, restructuring and modernization, with the defined purpose of adapting and integrating the institution to the new historical realities.

In this complex process of transformation and adaptation of the Romanian Army to the new historical realities, an essential element was the restructuring and transformation of the human resources management system into a system compatible with the existing systems within the alliance, flexible, dynamic, adaptable but and predictable for career soldiers.

Thus, since 2001, new regulations in the field of human resources have been adopted and new concepts have been implemented, such as military career, military career development [3], continuous training, as well as new approaches to the recruitment and selection of human resources.

Regarding the promotion of the military profession, the main effort was focused on two main directions of action, namely on the quantitative and qualitative recruitment of human resources - the processes of promotion of the military profession, recruitment and selection of candidates, as well as on initial and continuous training of military personnel, these being defining elements of the new approach.

From this perspective, the promotion of the military profession and the recruitment of candidates for military educational institutions, fit from a medical, mental and motor perspective and with a thorough education, was and is a central element and a constant concern for the decision-makers of the human resources management system in Romanian Army.

2.2 Motivation to choose the military profession

It is unanimously recognized that, in the choice of any profession, there are determining factors that are likely to substantiate a young person's decision to choose a certain profession over another, such as: salary level, working conditions, work schedule, working environment which activates the organization, the relations between employees, as well as the benefits related to the profession (ensuring professional development, granting bonuses and benefits, medical insurance, recreational packages, etc.).

In terms of choosing a military career, the defining elements could be: free education, a guaranteed job upon completion of undergraduate or post-secondary university studies,

a guaranteed and progressive income, a predictable career progression that provides a clear perspective on the future, as well as some material advantages associated with the military profession (compensation for rent payment or mortgage payment, as the case may be, free equipment, transport settlement, free medical assistance, etc.). With all these advantages offered by the military institution to young people who want to follow a military career, when choosing a profession they also consider the risks associated with this very specialized profession, such as: the incompatibilities and prohibitions imposed on military personnel by law, the risks associated in crisis situations or war, reduced systemic flexibility, strict military hierarchy, elements that can change the option.

So, we may consider that the options and behaviors of people in choosing a profession depend to the greatest extent on the motivational factors, but also on the implicit risks and compensations offered.

The studies carried out on the motivation of students and pupils from military educational institutions in choosing the military profession highlighted the fact that the main reasons behind the choice of the military profession were those related to the characteristics of socio-economic life, rather than the professional ones. Thus, the listed reasons were: job security, salary, gaining independence from parents. Of course, essential elements have also been identified that leave their mark on the option of the military profession: the aspiration to become a professional soldier for a young man can be considered a progress in his development, the relatively stable nature of the aspiration is a positive element that must be taken into account , the material advantages as the main motivation in choosing the profession, the pecuniary criterion is the second in the hierarchy, the first being represented by the social status.

The material stimulation of the military, as well as emphasizing their special status and the importance of their activity, are motivating elements that would ensure both the success of the selection through a larger selection base and the subsequent professional performances.

3. THE MILITARY PROFESSION PROMOTION CAMPAIGNS CARRIED OUT BY THE SPECIALIZED STRUCTURES OF THE ROMANIAN AIR FORCE

The disappearance of the myth of job security and the awareness of the current risks of the military profession have made today's young people more pragmatic, better informed about the world they live in and more determined in choosing their profession. However, the military profession and career offer many reasons to be chosen by young people, considering some advantages, which distinguish it from civilian professions. It is not to be neglected that attending a military educational institution ensures a job after graduation, to which is added the security of the profession and the evolution in the military career according to the capacities, real possibilities and own options. As far as social life is concerned, after placement, the graduates benefit from secure incomes and facilities for the family, as well as opportunities to assert themselves in fields related to the military field.

3.1 Purpose and objectives

The attractiveness of the military profession is an indicator of the way in which the army reacts and adapts to the conditions of a strong competitive environment that characterizes the market of educational and professional offers. The downward trend in the attractiveness of the military career among young people, which manifests itself nationally, indicated the need to develop strategies to promote the military profession that take into account, on the one hand, the developments on the labor market, the size and characteristics of the groups target, and on the other hand, the changes produced in the

structure of the armed forces, as well as the impact of the new military technologies recently introduced into the army's equipment.

In order to promote the military profession in an integrated and unitary way at the level of the entire army, strategies for the promotion of the military profession were developed for the period 2016-2020, respectively 2021-2025, with the aim of supporting the recruitment of human resources through proactive, modern methods , with impact on target groups.

The campaigns to promote the military profession and the educational offer carried out by the General Staff of the Air Force in the period 2018-2023, had as their **main purpose** the support of the recruitment process of quality human resources, necessary for the full occupation of the places put out for competition in the military institutions of education from the Air Force, provided in the schooling plans and the direct presentation to the target group (students in the final years of high school), the educational offer of the military educational institutions of the Air Force, respectively the "Henri Coandă" Air Force Academy and the Military School of Military Warrant and Non-Commissioned Officers of the Air Force "Traian Vuia".

At a secondary level, indirectly, through promotion campaigns, the image of the Romanian Army, in general, and of the Air Force, in particular, was promoted and projected in the civilian environment, as well as the current and perspective concerns of the military institution.

Also, the systematic and coherent dissemination of information and messages in the civilian environment was considered, in order to maximize the perception of the audience groups on the military profession and determine their option for the military career.

The carried out campaigns were characterized by national coverage, own visual identity, the diversity of means of communication with the target audience, the convergence of messages, by consistency and transparency in the provision of objective and relevant information regarding the educational offer of the Air Force.

The objectives of the promotion campaigns of the educational offer of the military education institutions of the Air Force were similar to the objectives established by the strategies for the promotion of the military profession, respectively: ensuring a consistent flow of candidates who opt for the military career, with an aptitude-motivational profile suitable to the requirements a military career in the Air Force as aeronautical personnel; increasing the share of young people in their final years and in their first professional option who request enrollment in the selection process; ensuring the sufficient number of candidates for personnel categories, weapons/services and military specialties specific to aeronautical personnel; increasing the degree of correct, timely and transparent information of potential candidates regarding the educational offer; gaining the support of the support group, especially the families of the potential candidates and the teachers involved in the professional guidance of the students.

Also, for the transmission of messages among young people during the campaigns to promote the military profession and the educational offer of the Air Force, in addition to direct interpersonal communication with potential candidates, the advantages of the online communication environment were used, the preferred medium for the transmission messages and their capture among young people.

Promotional efforts have focused on the target group of potential candidates in their final years of high school, which can make it possible to target the message to other segments of the target group they belong to.

3.2 Conduct of campaigns for the promotion of the military profession

The Air Force Staff, through the Personnel and Mobilization Office, assumed the role of initiator, integrator and coordinator of the campaigns to promote the educational offer of the military educational institutions of the Air Force.

In order to give the necessary consistency to this ambitious project, representatives of the "Henri Coandă" Air Force Academy and the "Traian Vuia" Air Force Majors and Non-Commissioned Officers Military School were invited and participated in these promotion activities, respectively students, students, teachers, instructors, as well as representatives from the military units-aeronautical personnel, military cadres from the military units deployed in the areas where the promotion activities were carried out. A complete team to introduce young people to what a military career in the Air Force is all about.

Also, the representatives of the regional and county military centers were involved and participated in the promotion campaigns, in the structure of which the information and recruitment offices operate, structures of the army specialized in the recruitment of potential candidates, but also in activities to promote the military profession. They, together with the representatives of the school inspectorates, determined the places for promotion activities, as well as the participants. Depending on the established place and the local possibilities for the direct promotion activity, they were requested to ensure the presence of the target group, respectively students of the XIth and XIIth classes, but also other people interested in the military career.

In order for such a promotion campaign to be successful among young people, to be visible in the public space and to generate the desired effects, promotion and advertising played a very important role.

The principles that were the basis of the campaign to promote the military profession were coherence, convergence, flexibility, proactivity, transparency, continuity, neutrality of messages, national coverage and efficiency.

The advertising campaign design strategies used consisted of: informative actions with the local and national media; actions specific to the advertising campaign; public relations actions.

Channels for broadcasting actions and promotional products used in the campaigns were: social networks, widely used by young people - Facebook, Instagram, Twitter; press (daily/periodical, national/local); the radio, which has as its main advantage the selectivity of the audience in a differentiated way depending on the day, the time of transmission and the show; the television; transmission of the promotional activity at peak audience times within the news programs. They proved to be of maximum effectiveness as a type of promotion: promotional films, printed leaflets, brochures, promotional gifts and other non-conventional means (pens, t-shirts, badges, military accessories).

The central message of the promotion campaign focused on the statement: *The Air Force offers you a job, a career, a decent income, social protection, the possibility of affirmation and promotion based on performance criteria, social prestige. Instead, it requires professional competence, capacity for self-improvement, loyalty, fairness, discipline, physical and mental strength, the ability to take risks.*

The participants in the promotion activities had the opportunity to come into direct contact with the students and pupils from the military educational institutions, with fighter and transport pilots from the Air Force, but also with some of their equipment. They held discussions and exchanged views on military careers, and the results of these actions were visible and positive.

At the end of each presentation of the educational offer, demonstration flights were performed with military combat and transport aircraft from the Air Force equipment, a

moment highly appreciated by young people and assistance, with a major impact on their decisions.

3.3 Analysis of the results of promotion campaigns

The results or effects of the campaigns to promote the military profession carried out by the Air Force in the period 2018-2024, must be analyzed both from the perspective of achieving the general objectives established, in relation to the audience groups, but also from the point of view of the positive image effect obtained at the level local and national for the Romanian Air Force and Army.

For the first aspect, the feed-back was easier and faster to observe, the assistance present at the promotional activities being impressed by the way it was carried out. For the second aspect, the periodic survey of public opinion is the most relevant tool.

Starting with March 2018, the Air Force carried out extensive campaigns at the national level to promote the military career and the educational offer of its own military education institutions, and the results were visible through the significant increase in the number of people who requested information from the offices information-recruitment regarding a military career in the Air Force, the number of people who requested information via the Internet, the number of accesses to the website dedicated to recruitment, the total number of candidates recruited for the military profession, the number of requests for information, interviews, reports from the media side, the number of positive reports appearing in the media about the professional offer of the Ministry of National Defense, the recruitment and selection procedures, the working and living conditions of the military, as well as the number of requests received by the Air Force from various institutions /organizations, in order to participate in local or national events.

Following the post-campaign analysis, it was observed that the number of candidates/place for admission increased considerably in the period following their implementation. According to a study carried out at the level of Air Force Staff in 2020, regarding the effects and results of the campaigns to promote the military profession among young people, carried out between March 2018 and February 2020 throughout the country, the percentage regarding the occupation of the places put up for competition from The "Traian Vuia" Military Majors and Non-Commissioned Officers Military School has increased the specialization of military majors from 38% to 65%, and for non-commissioned officers from 68% to 74% in the direct stream, respectively from 13% to 100% in the stream indirect training. Also, the percentage of occupation of the places open to competition at the "Henri Coandă" Brașov Air Force Academy increased, in the same period, from less than one candidate per place (subunit), to 3-4 candidates per place, the flow of entrances to military educational institutions in the Air Force being ensured.

It should also be mentioned that a very important element for the selection of candidates who opt for a career as a flight attendant in the Air Force consists in the medical-psychological selection carried out by the National Institute of Aeronautical and Space Medicine "General doctor aviator Victor Anastasiu".

Analyzing the promotion period of the last five years, it is found that the admissibility rate was approximately 18% (internal analyses). Statistical data indicate a relatively low percentage of admissions among graduates of national military colleges compared to graduates of civilian colleges.

4. CONCLUSIONS

The complex processes of adapting the military system to the new Euro-Atlantic realities naturally generated the need to adapt the human resources management systems in the Romanian Army, and the transition from the army based on compulsory military service to the one based on volunteering, required the repositioning of the profession military on the labor market, especially in relation to the competition represented by the civilian environment, where the abundance and consistency of job offers are much more attractive and tempting for young people who are on their first professional option in life.

Also, the constant and continuous decrease in the number of candidates for military educational institutions caused by the previously presented realities required the assessment of the existing situation, the analysis of the causes and consequences in the short, medium and long term, not only for military education, but especially , for the future of the professionalized human resource in the army and the implementation of measures and actions likely to bring back the interest of young people in the military profession.

The campaigns to promote the military profession and the educational offer of the Air Force, respectively, the "Henri Coandă" Air Force Academy and the "Traian Vuia" Military School of Military Warrant and Non-Commissioned Officers of the Air Force, had as their main objective the attraction of future candidates for their own educational institutions and, secondarily, the promotion in civil society of the current and future concerns of the Air Force, as well as the public image of the institution.

The activities were also a good opportunity for networking between all actors involved in the process of recruiting young people for the military profession, the support group made up of teachers, students and military students, teachers and representatives of military educational institutions and military personnel of military units.

The campaigns to promote the military profession and the educational offer of the military educational institutions of the Air Force addressed in particular the target group consisting of high school/college students in their final years and had the role of helping young people to define their personal options regarding the professional career. In direct relation with the young high school students, the representatives of the military education institutions explained to them their personal journey, how they prepared for the selection tests (motor testing, psychological and medical evaluation), how to prepare for the entrance exam and how interesting and valued is the life of a military student.

Also, the high school students received direct information regarding the military career, opportunities, courses in the country and abroad, international missions in which they can participate, but also the benefits of choosing the military profession.

The areas where the campaigns to promote the educational offer were carried out were chosen taking into account scientific elements, namely, the low level of youth employment, the relatively high level of training of young high school students, the high demographic density (the corresponding selection pool), the interest manifested for the military profession by the young people of this area, very limited possibilities of employment for young people due to the lack of the appropriate economic and social environment.

Considering the fact that, in the current context, attracting future candidates for military educational institutions is a complex and arduous process, it is necessary for the Romanian Army in general and the Air Force in particular to continue the campaigns to promote the military profession constantly and continuously, in all social environments, a fact that will lead, sooner or later, to the expected result, namely the provision of the human resource so necessary for this institution, vital for the fulfillment of the assumed constitutional missions.

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THE ROMANIAN ARMED FORCES - ORGANIZATION AND SYSTEM

Răzvan-Ștefan BICHIR

"Carol I" National Defence University, Bucharest, Romania (brsro@yahoo.com)

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***Abstract**: This analysis explores the intertwined concepts of organization and system in defining the armed forces' role and purpose within society. Drawing from systemic theory and organizational studies, it delves into the complexities of societal structures, emphasizing the armed forces as a crucial component of a vast functional system. Examining various conceptual approaches to organization, the study delineates typological divisions and criteria for categorizing organizations, underscoring the armed forces' unique position as a socio-economic, adaptive, and technical-material system. Ultimately, it highlights the dynamic interplay between the armed forces and society, raising pertinent questions about their role, impact, and ethical implications.*

***Keywords**: Armed forces, organization, system, society, functional system, systemic theory, typology, social structures, social impact, military ethics.*

1. INTRODUCTION

An analysis regarding the definition of the armed forces in terms of two concepts, organization or system, requires not only to focus on the two terms - organization and system - but also to determine the aim and, last but not least, the purpose of the armed forces.

To begin with, we will approach society as a system, and then, in approaching it as an organization, we will return to its systemic dimension.

2. SOCIETY - A HUGE FUNCTIONAL SYSTEM

Considering society a global social system and its components as a complex systems is a relatively new research method and it belongs to the general theory of systems created by Ludwig von Bertalanffy in 1937. This is a theory of organized complexities, which seeks to formulate principles, laws, concepts and systems methods. It is a scientific discipline of synthesis, which is based on a series of mathematical disciplines (information theory, strategic game theory, decision theory, operational research, differential equation theory, probability theory, abstract algebra, etc.), which gives it the advantage of introducing mathematical precision into research.

If we take into account the definition according to which the system represents a set of elements (principles, rules, forces, etc.), dependent on each other and making up an organized whole that puts order in a field of theoretical thinking, it regulates the classification of the material in a field of natural sciences or makes a practical activity work according to its intended purpose, then it can be concluded that everything that

exists in nature and society can be viewed as a system whose complexity can be judged according to the extent of internal processes and the consequences generated by its operation.

Therefore, human society and, ultimately, even the universe as a whole, represent a huge functional system, made up of a multitude of subsystems which are extremely complex and dynamic, with their own structures, mechanisms and functionality, with mutual and deep inter-conditioning. They are structured in such a way that the changes recorded within one of them produce effects in the operation of the others and, as a consequence, in the functionality of the overall system.

Systems cannot be thought of and created as autarchic, isolated and independent structures. In order to function, it is mandatory that they be interconnected with other similar or different systems. Material, informational, human, economic, etc. exchanges are established among them. At the same time, the real results of the operation of some systems are taken over by other systemic structures, which process the assimilated product, generating in turn other different products, which continue the cycle in a process that has no beginning and no end.

So, functional systems are characterized by the ability to assimilate various flows from the outside, to process them with the help of their own functional structures, to generate structures different from those entered into the system, which will be used either for their own needs or for the establishment of flows that will be outsourced.

Under no circumstances, however, does the functionality of the systems represent an end in itself, on the contrary, it only makes sense if the objective/purpose for which these systems were created is clearly known.

Any functional system is characterized by a state of dynamic balance, which is actually a result of the interaction between two or more contradictory processes manifested between its components.

In a philosophical view, the concept of balance expresses an essential moment of dynamic systems' stability. By the state of balance it is implied that between the component elements of the system - an optimal combination of relationships and interconnections is established on long term, which ensures the functionality of the system under the conditions in which the outcome is maximum.

In a dynamic and often unpredictable world, internal and external forces act upon each system which, by combined action, tend to bring it to a state other than that in which the values of the functional parameters that ensured the maximum results are modified . In the conditions where the action of the forces succeeds, it is obvious that the outcome of the operation of the system is reduced.

Any dynamic system creates and maintains a governance component - either rationally or just as an adaptive reaction to the environment. This component has the ability to steer the system, to establish strategic targets, to make sure that it possesses the necessary resources to function, to analyze the action of disruptive factors and to adopt strategies aimed at maintaining the optimum in its performance.

In the complex process of systems governance, information represents the basic element that ensures decision-making process consistency, regardless of whether it is conceptualized or reflexive. An effective management activity - demonstrated by the optimal functioning of the systems cannot be conceived, without real information supporting the adopted decisions. In order to be correct, the decisions adopted at the level of coordination and management structures, must be based on correct information- both regarding the system's functionality (that is the value of the characteristic parameters), and related to the value of the representative parameters of external factors, which act upon the system, tending to change its entropy.

Correct information involves effective information collecting tools, as well as the processing and operative delivery of decisions.

The coordination and management centers analyze the received information, pinpoint the deviations from what is considered to be the normal value of the functional parameters, as well as adopt the decisions delivered on the information flow, which are intended to correct the irregularities found in the system's functional process.

It is easy to understand that, in order to be in a permanent contact with all the components of the system, the management structure needs mechanisms for tracking and collecting information, which are capable to synthesize the collected data and deliver optimal information to the coordination and management center.

In another step, these mechanisms must follow the way in which the measures ordered by the coordination and management center were applied and the effects generated by the application of these measures.

On the other hand, these mechanisms must follow and report any disturbance registered in the operation of the system. For this, it is necessary that, at their level, the values and limits between which the system works optimally be known. Knowing these values, tracking mechanisms can detect abnormal deviations and inform the coordination and command center about functional anomalies. These tracking and control mechanisms have the possibility to act automatically within the limits of pre-set competences in order to correct certain categories of malfunctions, or they can only remain at the stage of collecting and transmitting data and information.

3. ORGANIZATION-CONCEPTUAL APPROACHES AND TYPOLOGICAL DIVISIONS

While studying various speciality materials, I came across an approach, which I consider very interesting in relation to defining an organization, and consequently, would be suitable for our study of the armed forces.

The specialized literature offers a wide variety of approaches regarding the organization - the structural and procedural component of the national economy and society, at the level of which economic goods are produced with the aim of satisfying social needs -, deeply marked by the degree of macroeconomic development, by the roles that macroeconomic and social management attributes to them, the centralization/decentralization relationships existing at a given moment in the economy and in the society, etc.

Regardless of the way an organization is viewed, it is unanimously recognized that it represents "a group of people who carry out joint activities aimed at achieving one or more objectives".

A similar definition is also proposed by R. Steers, in the sense that "organizations are collectivities of individuals and groups that work together to achieve shared objectives."

Moreover, starting from the origin of the word, derived from the Greek organon (tool or instrument), M. Vlăsceanu believes that organizations are "tools for achieving a goal, respectively that they have a set of specific and clear objectives, and their internal structure is designed in such a way that it can contribute to the achievement of the objectives." Their multiplication (extension), as well as their presence in practically any field of economic-social life, led to the conclusion that contemporary society is a "society of organizations", whose value is decisively marked by the value of the organizations that compose it.

H. Mintzberg showed (in 1989) that a society of organizations is one in which organizations infiltrate and insinuate themselves into our lives in such a subtle way that

they often end up not only controlling or influencing, but also dominating them. As the aforementioned author remarked, "it is an irony of fate that the organization, probably initially intended to serve its objectives, interests and goals, finally ends up, not supporting but exploiting it, not offering it benefits and satisfactions, but discontents and sufferings, not to offering it a generous space for thought and action, but, on the contrary, limiting it to the point where sometimes freedom and dignity themselves are threatened."

Hence the need for a comprehensive approach to the organization and its intimate functioning mechanisms. First of all, as O. Hoffman showed, the organization is defined by: individuals and groups, tasks and technology, structure, processes and, as an essential aspect, management.

H. Mintzberg also showed that organizations mean the collective action of pursuing a common mission, a disguised way of saying that a bunch of people gatherin order to produce a service or product of some kind. Amitai Etzioni highlights the fact that organizations are social annuities (or human groups) built and reconstructed intentionally to pursue specific objectives.

All these definitions highlight several particularities:

a. organizations are groups of people which run work processes in order to to achieve common and specific objectives.

b. organizations cannot exist without appropriate management, by which the objectives are established (forecasting), the procedural and structural-organizational conditions necessary for accomplishing them (organization) are ensured, the coordination of the individuals' efforts and their training-motivation, depending on the results are ensured, and each one's performance is adequately controlled and evaluated.

c. organizations have a formal organizational structure, focused on well-defined principles, rules and relationships that are unanimously adopted and respected by the group's members.

Without going into further details, from a predominantly socio-human perspective, the organization is:

- a structured system of human interaction in order to achieve common and specific objectives.

- a collectivity oriented towards the pursuit of relatively specific goals and presenting relatively highly formalized social structures.

- a collectivity whose participants pursue multiple interests, both different and common, but who recognize the significance of the perpetuation of the organization as one which represents an important resource. The informal structure is very powerful and allows the understanding of organizational behavior better than the formal structure.

- a system of interdependent activities linking the changing coalitions of the participants; the system is imprinted in -, dependent on continuous exchanges with -, and formed by - the functional relationships.

By reviewing the coordinates that determine its appearance and functionality, we manage to highlight the fact that the organization is a "socio-human construction", it is a "socio-cultural reality", whose "human purpose" is represented by the satisfaction, from multiple points of view , of the individual who created it.

From this perspective, two ways of treating the organization are outlined: a functionalist one, according to which the problems it faces are subordinate to accomplishing performance, work processes being a means of fulfilling the organization's purpose. Employees benefit from great "power" to fully bring their contribution to achieving results; another, a democratic one, which offers employees a greater control over important aspects of their work and life in the organization.

They participate both in achieving the goals of the organization and in satisfying their own interests. Regardless of the approach, we highlight the fact that the organization is, at the same time, a source of social change and motivation and responsible for social successes and failures.

4. TYPOLOGY OF ORGANIZATIONS

Next, we will present some criteria for categorizing the organizations and, obviously, the main types of organizations, with their defining characteristics:

a. Form of ownership and management of the heritage (public-private axis):

- public organizations (belonging to the public sector, managed by the state);
- private organizations (belonging to the private sector);
- independent or non-profit organizations (belonging to the independent or non-profit private sector, but which can be categorized according to their purposes, by offering for consumption some "collective goods").

b. Mode of operation (dominant management system):

- mechanistic (bureaucratic) organizations;
- organic organizations (also found in human-centered management).

c. Prevailing organizational structure:

- organizations with a simple structure;
- mechanical bureaucracies; professional bureaucracies;
- organizations with cut-out (divisional) structures;
- adhocracy (organizations with matrix structures).

d. Organizational analysis models, centered on two criteria: the relationship between organizations and the environment, respectively the functioning of organizations as systems:

- closed and rational organizations: open and rational organizations; closed and natural organizations; open and natural organizations.

e. Dimensional characteristics:

- large-sized organizations (found mainly in the form of enterprises or companies), medium-sized, small-sized, very small-sized (micro-enterprises).

f. Nationality:

- national, mixed, international, multinational, translational organizations

g. Membership to the sectors of the national economy:

- organizations from the primary sector, from the secondary sector, from the tertiary sector (services)

h. Membership to branches of the economy:

- industrial, agricultural, trade, tourism, transport, construction, culture, education, research-development, local and central public administration, banking, etc. organizations.

The typologies presented above highlights the following essential aspects in their managerial approach:

- each of these types has a well-defined place and role in the economy and the society;
- each one acts in a different, national and international environment, with variables with different percentages. Overall, this environment is very complex, turbulent, unpredictable, and the form of reaction to its challenges can be unique, depending on the managers’professionalism.
- each benefits from a specific management, which tries to capitalize on both endogenous and exogenous variables that mark the establishment and functionality of the respective organization.

- each capitalizes on a varied range of resources (material, financial, human and informational) in obtaining goods (products or services) aimed at satisfying certain needs.
- each is marked by variable work processes (management and execution), whose finality is decisively influenced by managers and executors' competence.
- finally, the degree of interdependence among the various types of organizations is increasingly stronger, even in the situation where managerial decentralization is increasing and, implicitly, the decision-making and operational autonomy is wider (we are primarily referring to public institutions -so called "decentralized")

Returning to the typology of organizations, even if each one has a special place and role in the economy and society, there is minimal appreciation according to which the organization or enterprise has a special importance.

As predicted by O. Nicolescu and I. Verboncu, two important concepts have emerged in the approach to the organization: the first concerns the priority given to the organization in the wider context of economic activities, on its profitability depending on the well-being of all economic and social actors, including the national economy ; the second one places the national economy first, underestimating the role of its component enterprises.

If the latter is overcome, it is obvious that, in order to be effective, a national economy must include and be based on profitable, competitive enterprises. Why? Because work processes are designed and carried out at their level, the real economic substance is produced by them, large countries' economic power and living standard being dependent on their profitability.

The organization or enterprise is, therefore, a group of people, organized according to certain legal, economic, technological and managerial requirements, which design and carry out a complex of work processes, most often also using certain means of work, embodied in products and services , generally in view of obtaining a profit that is as high as possible.

The organization or enterprise has a much wider scope, it is not limited only to the economic field, its object of activity can be from any field, provided that it has in view of obtaining profit. Within each country, besides companies, which predominate numerically, there are also numerous cultural, educational, health, etc. institutions, intended to satisfy the social needs of the population, financed by the state, trade unions, various public organizations and foundations, etc.

Seen as a system, the organization presents several defining dimensions or features:

a) The organization is a complex system, as it incorporates human, material, financial and informational resources, each of which is made up of an appreciable variety of elements. Human resources are composed of all the company's employees, who present different characteristics from the point of view of the level of training, specialty, position held, age, sex, seniority in the unit, etc. The set of raw materials, materials, fuels, together with machines, buildings and other materializations of production factors, each presenting certain dimensional, functional and economic parameters, represent the material resources. The financial availability, in cash and at the bank, available to the organization, form its financial resources, information, both of exogenous and endogenous origin, embodied in forecasts, technologies, consumption or quality norms, accounting or technical-economic records, statistics etc., make up the organization's informational resources. It should be noted that the four categories are combined, giving birth to different subsystems within the enterprise, such as construction sites, production sections, workshops, the transportation system, etc.

b) The organization is a socio-economic system, in the sense that, within it, groups of employees, whose components are in close interdependence, carry out work processes

that generate new uses. Human resources' quality – (that of being the main producers of new values) – gives them a central position within the enterprise, whose consideration is essential for the effectiveness of the activities that are carried out.

c) The organization is an open system, in the sense that it manifests itself as a component of numerous other systems with which it is in continuous relations on multiple levels. Actually, its character as an open system is expressed by the input flow - machinery, raw materials, materials, fuels, electricity, information, money - and by its output, mainly products, services, money and information intended for the systems which it is a part of.

d) The organization is an adaptive organic system, that is, it changes permanently, under the influence of endogenous and exogenous factors, adapting both to market evolution and to the requirements generated by the sustained dynamics of the incorporated resources. It should be remembered that the enterprise is not a passive system, but, in turn, it influences by its output some of the characteristics of the systems with which it comes into contact. The share of this influence depends on the nature, absolute and relative size of the outputs it generates, etc.

e) The economic organization is a technical-material system, in the sense that between the labour means, the raw materials and the materials used within it there are certain links that are manifested by the technological interdependence among its subdivisions, obviously with priority among the compartments in which production activities are carried out.

f) The analysis of industrial companies in the Romanian economy reveals their predominantly operational character. Actually, most of the work processes within them have an effector character. The organization is valid both for the execution attributions, primarily the production ones, which represent the majority of them, as well as for the management ones. Managerial processes of strategic and tactical nature, although particularly important, still have a small share at the level of commercial companies and state companies, manifesting in the form of forward-looking decisions adopted by the upper management, usually the general meeting or the directorate.

If we analyze the study presented above, which we have divided into four sections (A,B,C,D), and at the same time, we compare it with the idea expressed in our article, we can draw certain conclusions:

Section A:

a) regardless of the way the organization is treated, the armed forces represent a group of people who carry out joint activities aimed at achieving an objective, in our case the defense of the national territory and national security, etc.

b) the armed forces are a collective of individuals and groups that work together to achieve shared objectives; if we take the origin of the word, derived from the Greek organon (tool or instrument), we can consider that the armed forces represent a tool for achieving a goal, i.e. they have a set of specific and clear objectives, and the internal structure is designed in such a way that it can contribute to the achievement the objective of national defense.

c) yes, we can say, as H. Mintzberg also showed (that a society of organizations is one in which organizations infiltrate and insinuate themselves into our lives in such a subtle way that they often end up not only controlling or influencing, but also dominating them). As noted by the above-mentioned author, we can say that the armed forces initially assigned to serve its objectives, interests and goals, finally ends up not supporting society but exploiting it, not offering benefits and satisfactions, but discontents and sufferings, not providing a generous space for thought and action, but, on the contrary, limiting it to

the point where sometimes freedom and dignity themselves are threatened - see military dictatorships, attacks against other states, armed interventions on one's own people, etc.

Section B:

a) first of all, as O. Hoffman pointed out, the armed forces are also defined by: individuals and groups, tasks and technology, structure, processes and, as an essential aspect, management.

b) the armed forces also represents the collective action of pursuing a common mission, a disguised way of saying that a bunch of people gather under a distinctive sign, i.e. coat of arms, insignia, symbols, uniforms, combat technique, etc., so as to produce a service, in order to defend the homeland. We can also accept Amitai Etzioni's idea which highlights the fact that organizations are social annuities (or human groups) built and reconstructed intentionally to pursue specific objectives, see the organization and reorganization of the armed forces over time.

c) related to the definitions presented in relation to the organization and the parallel made, I highlight some particularities, which exist and are applied in the military system:

- the armed forces are a group of people who carry out work processes (training) for the achievement of common and specific objectives
- the armed forces cannot exist without a proper management, through which the objectives are established (forecasting), the procedural and structural-organizational conditions necessary for their realization (organization) are ensured, the coordination of the efforts of individuals and their training-motivation depending on the results is ensured, each person's performance is adequately controlled and evaluated.
- the armed forces have a formal organizational structure (organizational statements drawn up down to the smallest details), focused on well-defined principles, rules and relationships unanimously adopted and respected by the group's members.

Without going into details, from a predominantly socio-human perspective, the armed forces are:

- a structured system of human interaction in order to achieve common and specific objectives.
- a community focused on pursuing relatively specific goals and presenting relatively highly formalized social structures.
- a community whose participants pursue multiple interests, both different but also common, but which recognize the importance of the perpetuation of the armed forces as because they represen an important resource. The informal structure is very powerful and allows the understanding of organizational behavior better than the formal structure does.

By reviewing the coordinates that determine its appearance and functioning, we arer allowed to highlight the fact that the armed forces are a "socio-human construction", a "socio-cultural reality", whose "human mission" represents the satisfaction, from multiple points of view , of the individual or the society that created it.

We can also mention that the two ways of treating the organization are also emerging in the military system: a functionalist one, according to which the problems it faces are subordinate to its performance, work processes being a means of fulfilling the organization's purpose. Employees benefit from great "power" to fully bring their contribution to achieving results; another democratic one, which offers employees greater control over important aspects of their work and life within the organization.

Section C:

Regarding the typology of organizations, the armed forces are a public organization with exclusive state funding, with a well-established, closed and rational structure, large in size, but composed of small organizations (battalions, if we refer to the states of

organization), national in the tertiary sector , being represented by the Ministry of National Defense.

Section D:

In this section we start from the approach of the organization as a system, with several dimensions or defining features, analyzing the fact that the military can fit into these features.

The armed forces can be considered a complex system, as it incorporates human, material, financial and informational resources, each of which is made up of an appreciable variety of elements. Human resources are composed of all military personnel, which present different characteristics from the point of view of the level of training, specialty, position held, age, sex, seniority in the unit, etc. The set of raw materials, materials, fuels, together with machines, buildings and other materializations of the training system (assimilated to production factors), each presenting certain dimensional, functional and economic parameters, represent the material resources. The financial availability, in cash and at the bank, at the disposal of the military units, forms its financial resources, the information, both of exogenous and endogenous origin, embodied in forecasts, technologies, consumption or quality norms, accounting or technical-economic records, statistics, etc., form the informational resources of the armed forces (organization). It should be noted that the four categories are combined, giving birth to different subsystems within the military organization, such as training grounds, ranges, car parks, storage sectors, etc. (building sites, production sections, workshops, transport column, etc. of other organizations).

The armed forces are also a socio-economic system, as, within it, groups of employees, whose components are in close interdependence, carry out work processes that generate new values. The quality of human resources to be the main producers of new values gives them a central position within the military units, whose consideration is essential for the effectiveness of the activities carried out.

We can say that the military organization is an open system, in that it is in continuous relations on multiple levels. Specifically, its character as an open system is expressed by the input flow - technology, raw materials, materials, fuels, electricity, information, money - and by its output, mainly the service of ensuring national sovereignty and security, as well as information intended for the systems to which it belongs.

At the same time, we appreciate that the Military Organization - the Armed forces are an adaptive organic system, that is, it changes permanently, under the influence of endogenous and exogenous factors, adapting both to the evolution of the military equipment market and to socio-political factors. Also, the armed forces are not a passive system, but, in turn, it influences through its capabilities and some of the characteristics of the systems with which it comes into contact. The weight of this influence depends on the equipment, the degree of staff preparation and trening, etc.

As an economic organization, the armed forces are a technical-material system, in that between the means of work, the raw materials and the materials used within it there are certain links that are manifested through the organizatonal dependence between its subdivisions, obviously with priority between the compartments in which combat training activities are carried out.

The analysis of the military units in the Romanian armed forces reveals their predominantly operational character. Specifically, most of the work processes within them have an effector character. This is valid both for execution attributions, primarily instructional ones, which represent the majority of them, as well as for management ones.

Managerial processes of a strategic and tactical nature, although particularly important, still have a low weight at the level of military units, manifesting themselves in the form of perspective decisions adopted by the higher management sample, usually the Defense General Staff.

5. CONCLUSIONS

From what is presented comparatively in sections A,B,C, it can be stated with certainty that the Armed forces are an organization, a group of people who carry out common activities to achieve an objective; a tool for achieving a goal, a set of specific and clear objectives; the pursuit of a common mission, a group of people gathered under distinctive signs, having a common goal; the existence of an appropriate management that establishes the objectives, ensures structural and organizational conditions for their achievement, control and adequate evaluation of the performance of each member of the entity; formal organizational structure-organizational statements drawn up to the smallest details, etc.

Regarding the aspects enumerated in section D, in which it is stated that the Armed forces are also a complex, socio-economic, open, organically adaptive, technical-material system, we can consider the Armed forces as a system, a subsystem within society, defined as a huge functional system.

Based on the aforementioned conclusions, we can state that, according to certain currents, the armed forces are an organization, while according to other trends they are a system.

From our point of view we could conclude that the armed forces are at the same time an organization, in that it represents a group of people with common goals and well-established objectives, organizational structure and well-defined material means, but at the same time they are also a system, since the activities are carried out according to well-defined laws within the global system. So we can state the fact that the ARMED FORCES ARE BOTH AN ORGANIZATION, AND A SYSTEM.

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FROM CLEAR SKIES TO ALL - WEATHER: THE EVOLUTION OF THE U.S. ARMY'S OPERATIONAL CAPABILITIES

Laurențiu-Ioan GĂINĂ, Sorin PARASCHIV

Boboc Air Force Base, Buzău, Romania (laurentiu.gaina@yahoo.com, sorinparaschiv_atu@yahoo.com)

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Abstract: *Nowadays, within the Air Force, pilots train for instrumental flying in adverse weather conditions. The instrument flight program developed by the US military over 30 years ago, from the end of World War I to the late 1940s, is still in use today in many pilot training programs around the world. During the development of this program, the military was at the forefront of technological development.*

Keywords: *instrumental flying, training programs, simulator, military aviation*

1. INTRODUCTION

Military organizations do not generally adopt technology and doctrine hastily. Innovation in the military is an evolutionary process, but it is inconsistent. The attitude of military personnel, availability of funds, technological advancement, operational requirements, and other factors control the speed at which an idea is accepted. This is also valid for contemporary fundamental ideas, such as that an airplane should be operational regardless of the prevailing weather conditions.

In this manner, the instrument flight program developed chaotically due to the factors listed above. The evolution process lasted almost 30 years, with the first phase being non-existent and the terminal phase becoming necessary. It began as an experiment in the 1920s, trying to evolve into operational based on a training program in the 1930s. Finally, in the late 1940s, it succeeded in becoming mandatory in the pilot training program for large-scale operations and flying in unfavorable weather conditions.

Instrument flying fully evolved in the late 1940s because the instrument management and training program of that period was very similar to that used today. Specifically the main characteristics of instrument flight in military aviation are:

• All pilots must fulfill a minimum number of hours per year and periodic examinations, both written and practical, to maintain their rating;

• Out of 190 flight hours for a pilot in training, approximately 40 hours are dedicated to instrument flight, to which the theoretical courses are added;

• The use of simulators is frequent, requiring 30 hours of practice.

This study aims to show the impact of this program, the evolution of the main elements, the instrumented aircraft, the pilots who tested the program and built the training plan, the evolution of the training programs, and the military operations that showed how effective it is. The program lasted three decades, during which the military gradually adopted instrument flight. The military was quite reluctant to adopt large-scale and rapid changes, so they partially implemented specific techniques until forced by a special event.

The army implemented this method for several times until the program became mature and reliable. This plan had three significant parts divided for each decade. Hence, after World War I, the army became permanently included in aviation. In the early 1920s, with the advent of permanent military aviation, it quickly began to develop navigational instruments and techniques. Pilots and engineers worked closely together on radio navigation, flight instruments, and airways. At the same time, the Air Force did not adopt instrument flight, even if it accomplished massive developments in the field, so aviation remained operational during daytime only, flying just in relatively good weather conditions.

This changed in the 1930s when it was recognized that the technology was perfected enough to be implemented; this was also supported by Jimmy Doolittle and William Ocker. Thus, the introduction of the limited instrument flight program for pilots took place. In 1934, the Air Corps took over airmail; this was a setback for aviation, demonstrating the poor training of pilots for instrument flying. After a number of 66 plane crashes and forced landings, military aviation began to take instrument flight much more seriously, increased the number of training hours, and introduced flight instrument management. It was also during this period that strategic bombing was introduced into the doctrine of war; this struggle made pilots obliged to be able to fly instruments. These changes were complicated to implement due to logistics. In the late 1930s, aircrew were trained to fly in all weather conditions, but this was seen as redundant and not a combat requirement by the crew. The pilots were not well trained and the program did not prepare them to be operational pilots in all weather conditions.

The Second World War showed the problems of the instrument training system with the advent of large-scale operations such as the bombing of the European Campaign. The US Air Force had to reorganize the entire program in the shortest possible time, implementing it for students and all Navigant personnel to meet operational requirements. The effort was successful, so the Army Air Corps was reborn after the war as the United States Air Force with all-weather personnel and training system, and the necessary infrastructure to continue operations. The training system remained in continuous development and refinement. In 1948, during the Berlin crisis, when it was blocked, and the only access point was by air, the importance of instrument flight became undeniable, not only for bombing campaigns. There was no incident, and this express the excellent training of the aircrew and the fact that the instrument training program has become viable and well-rounded. This training system is still applied today with minor differences.

2. THE TWENTIES

Throughout the twenties, the air services conducted more research into flight instruments but did not equip them in aircraft or aviator training in all flying conditions. There were several reasons why not much progress was made. Flight instrument technology was valid but not highly developed, especially navigation equipment. Many aviators were not enthusiastic about flying through the clouds. They learned to fly in World War I without the aid of instruments. They either did not trust instruments and flying through clouds or were pilots who believed they could fly in weather without artificial aids.

This problematic state changed by the decade's end when the Air Corps inaugurated the first pilot training tool. A combination of engineering achievements and the efforts of military instrument enthusiasts brought about this change. Improved technology made the all-weather flying routine possible and pro-instrument pilots convinced the hierarchy that

it was time for the Air Force to have the all-weather capability. The first requirement was the presence of advanced technology.

In the 1920s, the Army established an Instrument Section at McCook Field, Dayton, Ohio. The Instrument Section worked with instrument manufacturers and government agencies to develop flight instruments and determine Army requirements. Pilots and their engineers perfected an innovative flight instrument, the pitch and turn indicator. This device, first produced by the Sperry Company in 1918, consisted of an operational gyro needle that indicated the direction of turn and a steel ball in a glass tube (like a pendulum) that stated the inclination. After testing and improvement at Dayton, the pitch and yaw indicator became the primary control instrument for the first time in two decades of flight instruments. It allows pilots, for the first time, to control precisely their aircraft when they cannot see the horizon.

The development of radio navigation during this decade made the first all-weather airway and large-scale air operations possible. At these agencies' request, Air Services cooperated with the U.S. Post Office and the Department of Commerce in developing commercial application equipment. Early in the decade, the Air Service opened the first airmail routes before civilian entrepreneurs took over and publicized the first airways in the United States. In the late 1920s, these government projects produced radios, aircraft receivers, and cockpit visual and audio indicators. This equipment made weather navigation reliable for the first time and was quickly put on the market. These advances resulted from the work of many people, military and civilian. Many military engineer pilots who became known for their work were early proponents of instrument training. Lieutenant, later General Alfred F. Hegenberger, and Lieutenant, later General James H. Doolittle, were two supporting trainers from the aviation engineers.

Hegenberger worked in the Instrumental Section at McCook from 1919 to 1933, except for three years in Hawaii. During this period, he played an essential role in all the projects in this section. He designed the first standard displaying instrument for the military and built the first instrument with a landing system. The first attempts at radio-navigation flight in the U.S. were in June 1927 (the radios failed, but the crew survived) and the first instrument flight in May 1932. In 1934, Hegenberger was awarded the Coller Trophy, an international aviation award for his achievements and experimental work. He was also the first to recommend instruments and navigation training for military pilots in 1923. He later designed and taught the first Air Corps instrument-training course, but these were for specialists, not all pilots.

James H. Doolittle is one of aviation's most famous pioneers. His instrumental flight experiments are only a tiny part of his glittering career. In 1928, the Air Corps loaned Doolittle, who was already a public figure participating in aerial and endurance events such as air racing, to the Guggenheim Fund for the Advancement of Aeronautics. Doolittle's job at the lab was to find a way to land a plane through the fog. He and his associates spent a year building and testing instruments and radio-landing equipment. Their work was completed on September 24, 1929, when Doolittle made the first fully instrument-based flight. He took off, steered his aircraft through a predetermined route, and landed using only instruments. Doolittle's cockpit was covered with canvas, but in the other seat was a safety pilot, who was there in case of an emergency. This was hailed worldwide as a step forward in aviation safety and a demonstration that flight instrument technology had developed since the beginning of the decade.

In his summary of his work at Guggenheim, Doolittle confidently recommended that the Air Corps equip aircraft and train aviators for instrument flight. The new devices and techniques were not left in the laboratory; they were immediately exposed to the market.

Entrepreneurs quickly took advantage of the possibilities offered by the civilian development of flight technology. In 1926, the Bureau of Air Commerce intended to increase the development of the aviation trade and succeeded. He placed the commerce department in charge of creating airlines, airports, navigation facilities, and weather instruments for operational airlines. In the early 1930s, there was an extensive system of publication of flight lines consisting of radio-navigation signals, light beacons, emergency landing fields, and weather stations.

Later, the instruments acquired procedures according to the radio signals. They were developed to accept normal flight traffic in the cloud-covered airport. Commercial passengers and airmail operators at night and in inclement weather were routine in the late 1920s.

Despite the rapid development in which it participated, the Air Force remained in the experimental stage during the 1920s. It did not provide instrument flight training or require pilots to practice flying in weather conditions. It was a rise of operational pilots, not experimental engineers, who believed that instruments were crucial for poorly prepared pilots who could not master the true art of flying. The most critical instrumental lawyer was Captain, later Colonel William C. Ocker.

Ocker became a believer in instruments from World War I when, after several near-disasters caused by flying in clouds without instruments, he discovered that he could easily control an aircraft using a turn and slide indicator. Since then, he has not flown without one. He obtained his version, which he attached to the wing of any plane he flew. Ocker came to believe that the Air Corps lost many aircraft and aviators due to incompetence in flying in various weather conditions. The military stations of those times were suggestive but not conclusive. Since the Air Force did not train or operate in instrument conditions, instrument flight was not one of the customary categories that Air Service accident investigators recognized. It was considered that accidents were caused by lack of experience during flying and bad weather conditions; therefore, weather was a cause category. For example, during 1921-1922, 18% of all accidents occurred when the weather was unclear, and weather was determined to cause 5 % of accidents. At the same time, 55 % of accidents were not investigated, or the cause was determined for unknown reasons. Based on his experience, Ocker knew that pilots losing control of their aircraft during their attempt to fly through the clouds without instruments was the cause of this large number of unknown reasons.

In 1926, Ocker discovered a way to demonstrate that flight instruments were a necessity, not just a support for instrument flight. From that moment, he became an essential man in the field of military instruments. His discovery happened by accident during his annual physical flight. One of the flight tests consisted of rotating the pilots in a chair called the Barany chair and then stopping it almost instantly to determine how quickly their eyes recovered and focused. Dr. David A. Myers added a demonstration to the Barany chair test. He observed the pilots spinning while blindfolded. The intention was to show that, with sight, the sense of balance could be easily understood. Blindfolded, the pilots quickly lost track of the direction of rotation and could not feel the difference in acceleration or tell when the seat had stopped rotating. Ocker took the balance test, became disoriented like other pilots, and decided to try his experiment. He placed his yaw and pitch indicator in an opened box and tried the test again, this time watching the needle turn. He found that the flight instrument kept him oriented the whole time. This solidifies that pilots relying on their senses and experience was a myth. The human body cannot sense where it is going without sight. Pilots need help through instruments to fly when they cannot see out of the cockpit.

Armed with his ideas and his toolbox to prove them, Ocker became a crusader. He and Dr. Myerz reported their findings to the War Department, and Ocker began offering tours of the Barany chair to all interested pilots, both civilian and military. He also published articles, gave speeches, and developed additional records. In testing pilots between 1929 and 1932, Ocker found that 3% could maintain control of an aircraft for more than 20 minutes during flight in bad weather conditions. One aircraft, after reviewing Ocker's records, adopted instrument training and reduced its weather cancellation rate to less than 1% on specific routes.

Ocker's intention was not entirely to demonstrate that the instruments were necessary for flight operations in weather conditions. He wanted the Air Corps to add flight instrument training programs. While stationed at March Field, California, and Brooks Field, Texas, Ocker designed a program and trained a cadre of instruments. In 1932, Ocker and one of his assistants, named Carl Crane, published one of the first books on flight instruments. To supplement his flight training, Ocker designed and built devices to aid his training. Among them was an improved version of his demonstration needle return, which won a $1000 award from the National Aeronautical Certification Committee and was the first non-visibility flight instrument. The hood was a fabric device that enclosed the aircraft's cockpit to allow the pilot to simulate flying through clouds. Ocker also tried to build a machine that could simulate instrument flight without leaving the ground; he was unaware that a genius mechanic named Edwin Link was making the final changes on a working simulator that would later revolutionize training tools. In the late twenties, Ocker petitioned the Air Corps several times to adopt his training program and the equipment with it, but his proposal was not accepted.

Interest in flight instruments increased in 1930, when Ocker won several conventions in the Air Corps and the aviation community, gaining much publicity. The head of the Air Corps, General Lahm, was aware of Ocker's work but also of the fact that foreign airlines and companies were training their pilots with flight instruments. The program was for advanced students, being short and limited, but it was a start.

3. THE THIRTIES

The 1930 instrument program was more like an introduction to flight instruments than a course of Instruction. This program consisted of approximately 10 hours of flying (5% of the total hours a pilot must complete) and two hours of ground training. All students started with straight level flights and easy turns, progressing to more manoeuvres such as climbing, descending, and steep turns. Later in the course, they mastered solo instrument flight and compass orientation. In addition to all this, the students also practiced acrobatic maneuvers. This implementation was complex as there were not enough training aircraft to be equipped with flight instruments and no user manuals. Since instrument flying was new to the Air Force, the need of more qualified personnel was prioritized.

The Air Corps implemented an instrument technique based on the turn and pitch indicator. This was called "1, 2, 3", "A, B, C" or "x, y, z" depending on their variation. These procedures taught students that each aircraft's control surface (aileron, elevator, and rudder) corresponded to a single instrument indicator. For example, the rudder controlled the yaw with the A, B, and C methods. Each one was corrected or changed, thus creating a vicious circle. Student pilots were warned to avoid attempting to visualize the aircraft's position as this imposed step would slow down the process; the glide and airspeed indicators were understood after more practice. These were the best options until the advent of artificial horizons (now called altitude indicators), which were on the market but not widely available in the early 1930s.

In addition to being able to introduce an instrument course into the advanced training program in 1930, the Air Corps mandated that all pilots complete a minimum of instrument flight hours per year. However, instrument-equipped aircraft and instructors were rare in operational units as well as in training units. In addition, the pilots' lack of motivation to master the instrument flight was caused by the absence of flight controls or procedures that assured them the preparations were complete. The Air Corps did not take instrument flying seriously then, remaining only a daytime service. The Air Corps concentrated on traditional flying methods.

In 1934, President Roosevelt fired the airmail operators and gave the jobs to the Air Corps. General Benjamin Foulois accepted the mission immediately. Although he was aware of the limits of instrumental capacity, he worried about restoring the budget that had been consumed countless times. The Air Corps chief saw the mission as an operational test for the Airmen and a chance to show their capabilities. The requirements became challenging despite the General's reasons for accepting this assignment. The Air Force must operate for the first time in history under all environmental conditions and time pressure.

The Presidential Directive gave the Air Corps 10 days to prepare. The demands were so great that aircraft, pilots, and technicians had to relocate and prepare. This preparation included enormous efforts to install the instruments in the aircraft and prepare the training routine in adverse weather conditions for the mail flight line crews. A major drawback was that all this happened in the middle of the deadliest winter.

After a week of flying, numerous crashes were announced, their total number being eight destroyed aircraft, including five dead pilots and six in critical condition. The Roosevelt administration criticized the Air Corps. Thus, the military imposed much greater security measures for the operation, which reduced airmail services to a fraction of what the airlines delivered, therefore having to suspend operations so that the pilots of the instrument-training airline could be called in to assist the flight airmail. Fifty-two pilots flew missions in military aircraft. In June, at the project's final, there were 66 accidents, 12 fatal and 15 serious injuries.

A War Department investigated the project along with the entire Army program. The fact that many accidents were caused by weather and darkness played an essential role in the committee's findings. The investigators recommended that Air Corps pilots receive more flight time and training, which includes more darkness and bad weather. The Air Corps was also ordered to equip the aircraft with all the instruments used by the flight lines.

The Air Corps did not wait for the committee to find everything. In May, while the airmail operation was still in progress, instrument training was doubled for students, adding a 10-hour course in addition to the normal one. The curriculum ended up being remarkably similar to the advanced program. Students practiced basic and advanced maneuvers, navigation, and radio navigation if the facilities were in order. Instrument flying at that time covered 10% of the Air Corps' training pilot schedule.

Another consequence of the airmail episode was the significantly increased funding of the Air Force. From the budget allocated to them, the Army could buy many more high-quality instruments, equipment, and radios for aircraft. In April 1935, the Army ordered all joint training and attack aircraft to be equipped for instrument flight. In 1936, radio equipment was installed in all tactical aircraft, and in 1937, all Air Corps aircraft, except single-seat fighters, were equipped with flight instruments. The purchase of these instruments reflected the changing attitude toward flying instruments, and all of this resulted from the airmail mission.

The Air Corps decided in 1934 to monitor the instrument flight efficiency of all pilots, not just students. At the beginning of 1935, the minimum number of hours in instrument flight for all aviators was set at 10 hours annually. In addition, that same year, the Air Corps initiated a check to test all pilots' knowledge of the instruments. Every pilot should take an evaluation exam once every six months. Furthermore, commanders supervised the pilots to ensure that all practice hours were done according to schedule. These procedures constituted the first instrument flight management system. They illustrated the dramatic change in attitude that took place in 1934. Instrument flying was in this way seen as an essential skill. All pilots had to be competent for this type of flight. The Air Corps was on its way to becoming an all-weather service.

The need for all-weather service did not just grow out of the airmail mission, as there were other factors at work and observable changes in air doctrine. Strategic bombing became an essential part of the Air Corps' plans for the war. Along with its requirements for protective, long-range missions, strategic bombing involved the possibility of flying through clouds because weather conditions were rarely favourable over a large area. By 1935, the Air Corps tactical school emphasized instrument flying, close navigation, and formations, all necessary for bombing to reach the intended target. A tactical school study of the period showed that while storms immobilized ground and naval forces, aircraft, if well equipped, could operate in precipitation, high winds, and no vision. The required equipment included flight instruments, radio navigation, communications equipment, and an autopilot to maintain a proper course. This method of attack was of great help and, at the same time, showed that instrument flying had taken a permanent place in the Air Corps' thinking. Limited daytime and clear-sky operations have become outdated, at least on paper.

By the decade's end, the Air Corps had become the Army Air Forces (AAF), and instrument flying was well established. Annual instrument flying requirements rose to twenty hours a year, but when World War II began, the requirements dropped, and this type of flying became routine for new cadets. The pilot training curriculum has expanded to three phases: primary, standard, and advanced. Each stage includes instrument flight.

There was also an extension of instrumental training. The primary and advanced students flew the Link Trainer for fifteen hours, which had just become available. In Link, they could practice instrument manoeuvres and improve their flying technique without leaving the ground. From then on, all pilots will become familiar with Link and its following versions. Although the simulator had just arrived, it quickly became essential in pilot training. It enabled the expansion of instrument work that was much cheaper and safer than aircraft training.

4. LINK TRAINER

The Link Trainer was named after its inventor, Edwin Link. Mr. Link was the only one qualified to build the first working flight simulator. He was an expert engineer and mechanic who worked in his father's piano and organ factory. He was an aviator who learned to fly in the storm era in his spare time with whatever money he could scrape together. The high cost of flight training led Link to build a device that could replace some of the expensive flight hours required to learn the basics.

Link built the first simulator in 1929. It was constructed from a miniature replica of an aircraft (consisting of bushy wings and a tail section) mounted on a gimbals. The stick and rudder pedals in the cockpit activated a set of air cushions (no doubt inspired by Link's old career as an organ builder), which caused it to roll and pitch like an aircraft in flight.

During this time, Link piloted his flight school in Binghampton, New York, and used the simulator to teach students essential control of an aircraft without leaving the ground. This reduced the flight time required to acquire the license and lowered costs. In 1930, using the simulator, Link could allow a student to fly solo with 2 hours of flight compared to 15 hours for his competitors.

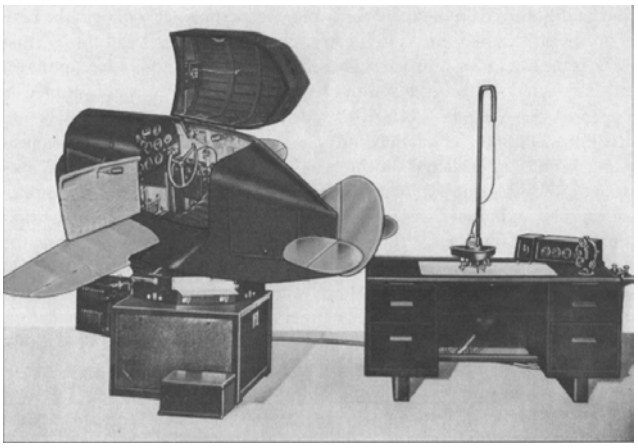

FIG.1 A Link Trainer device with the instructor's desk [3]

In addition to teaching, Link's business includes air service, such as air deliveries. To expand his capabilities, he obtained an instrument rating. Once Link was an instrument pilot, it was not long before he added a dashboard and flight instruments to the simulator and brought the first instrument simulator to market. That happened in 1931 when the aviation industry was unprepared for such a revolutionary concept. As a result, the Link Trainer was used in amusement parks for many years until it was taken seriously.

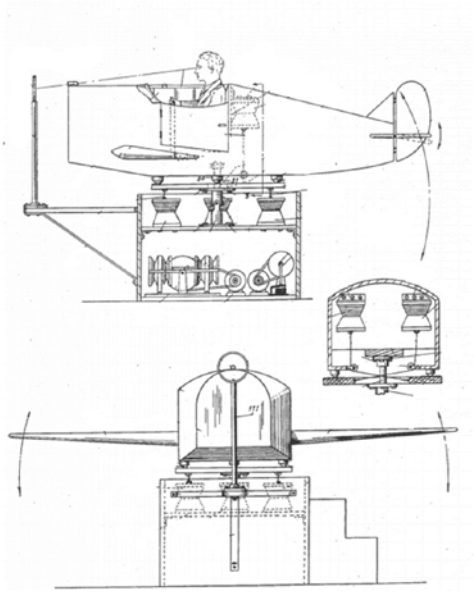

FIG.2 The sketches of a link trainer device [3]

Eventually, the word spread, and in 1934, the Air Corps, very interested in instrument training after the airmail flight, ordered six Link Trainers, initially Link. They were training a single group of pilots. At first, Air Corps orders were slow due to a lack of funds. However, other agents and government officials, realizing that the device offered a real-world experience at a fraction of the cost and without flight risks, steadily ordered

trainers in the 1930s. The US Navy, Civil Aeronautics Administration, airlines, and Air Forces of Germany, Japan, England, Russia, France, and Canada bought Link Trainers before World War II. The savings were numerous; Link used about 5 cents an hour of electricity compared to $10 for aerial training fuel. The Air Corps, which took over instrument training for good in the mid-1930s, made the Link the standard for pilot training in 1936 and continued to purchase them as funds permitted. By 1939, the army owned 40 Links (by comparison, the British Air Force had 200 simulators in 1939).

The US Air Force has found that simulator training can be economical in several ways. In 1939, he opened his first enlisted Link instructor course. Using enlisted instructors to teach instrument procedures (Link was primarily used for procedural and hands-on training) was cheaper than delegating pilots for coaching. During the war, hundreds of Link Trainer instructors were used to teach the prominent classes of pilots.

At the start of World War II, all Link production was reserved for the military only. Between them, the Naval and Air Forces bought 7,316 Links by 1945. The investment was worth it. The Air Force estimated that after the war, it saved 243 lives, $78,839,441, and 15,142,953 hours per year using the Link to train war aviators.

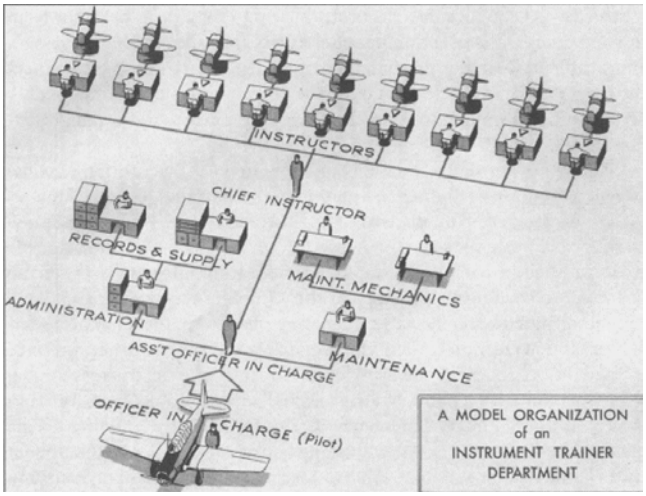

FIG.3 A model for organizing a pilot training department [3]

The trainers used in the war were quite different from the crude device of 1934. Edwin Link constantly updated the simulator, adding more capabilities and accuracy to an actual flight. The 1934 "A" model presented students with only the base. It had a compass, an airspeed indicator, a vertical speed indicator, a turn and pitch gauge, and a headset for receiving radio aural signals for navigation. Neither the Model A's instrument panel nor its flight characteristics resembled a real aircraft. It was just procedural training for memorization and practice; actual flying was learned in real airplanes.

During the war, Link Trainer's sections were organized as separate units into small groups with their administration, maintenance, and instructor divisions. The students were going through an entire course of instrumental training. They would start with the basics of controlling the aircraft, as they would in the flight program, and then learn complex manoeuvres and navigation using the aural radio range and other navigation equipment. The course also contained instruments for holding the landing slope and extensive instruction on radio communications. The course was comprehensive, covering every phase of instrument flight. The simulator has evolved from a simple introductory training aid to a complete and complex training system. Naturally, the possibilities of this simulator technology were not limited to instrumental training for students.

Edwin Link built various training devices for the military during the war. There were gunnery instructors, bombing instructors, navigation instructors, and even a bomber crew where the pilot, co-pilot, navigator, and bombardier could simulate an entire mission. Simulators were becoming specific to the weather.

By the 1950s, simulators were a staple feature of flight training. The Link Company produced combat simulators where crews could practice engaging and destroying enemy aircraft. There were also bombing simulators and transport simulators. All new aircraft had a proper simulator.

5. THE FORTIES

World War II began for the Air Force Training Command in 1939 when the War Department purchased several flight simulators. The first production run started with less than 300 examples in the 1930s. This rose to 4,500 a year, and with war approaching, the rate rose rapidly from 7,000 to 12,000 and finally to 30,000. This increase continued until 1943, when it reached 102,000, and the new training plans were detailed even without approval.

Pilot training has changed drastically. The duration of the three phases of the program has been compressed to increase effectiveness, and thus, the AFF has reduced the duration of drop training from one to seven months. Civilian contractors handled primary training, while the military focused on basic and advanced training.

Over the three phases, the student pilots flew 205 hours in the 1942 training program, including 30 hours of instrument flying. In addition to the 30 hours of instrument training that covered 15% of the flight, another 30 hours spent in the Link Trainer were added. Instrument flight hours were increasing for cadets training to fly in combat aircraft. For example, bomber pilots trained an extra 20 hours. Wartime weather predictions proved accurate, so pilots had to prepare for all weather conditions.

Disquiet over the instrument flying of AAF pilots had existed since the beginning of the war. A military investigation in late 1949 found that trainers were unqualified, training was irregular, and pilots completing the course lacked confidence in their abilities, thus disliking instrument flying. The AAF was also criticized for the fact that their program focused on trivial elements instead of focusing on gyroscopic instruments. A specialist training command blamed unqualified instructors and neglect of cadets for all the problems at a conference. During the meeting, Joe Duckworth emphasized that the AAF treats instrument flight training as an insignificant phase. Cadet training from 1943 reflected the problems and attitudes the AAF wanted to overcome, so all squadron commanders ensured that instructors were fully aware of the importance of instrument flying. The results that superiors wanted required changes in training systems.

To improve the instrument flying situation, the AAF took several actions in 1943, including schools for instrument instructors, a new program for instrument flying, and a standard method for flying by altitude indicator.

Unfortunately, adjusting the flight methods to the altitude of the gyro indicator remained a problem, as it had been part of the ship's standard equipment since the early 1940s. General Yount complained about the pilots' inability to use the gyroscopic instruments and the negligence of the equipment because the cadets were not familiar with the procedures. The general ordered aircrew and mechanics to familiarize themselves with the new instruments. All this made up a start but not a training program.

A much easier system to master was the whole panel system. The pilots could visualize the aircraft's altitude much more easily with the help of all the instruments, but mainly the artificial horizon.

Students learned to associate altitude with instrument indications. The Air Lines and the Navy were teaching aircraft control panels before the AAF. The director of training at the AAF engineering school, Col Joe Duckworth, knew the techniques well enough to apply the training syllabus to his students at Mississippi in 1942. In June 1943, the AAF standardized the control panel syllabus due to its success.

In 1943, the AAF took further steps to integrate full-panel flight and improve instrument training. Therefore, the AAF ordered a set of professional tools to cover every stage of the program, from basic maneuvers to landing the aircraft. In addition, in 1943, the AAF built schools for training instructors. Later, there was a school of instruction for each secondary training command.

In addition to revising pilot training, the AAF also changed procedures for operational pilots, and from 1943, all necessary instruments had to be on board ship. Each pilot must receive a certificate each year to maintain its instrument rating. To obtain the certificate, the pilot must pass a written test and a flight test through which he must do all the basic maneuvers. The certificate was of two types: white to green for the experienced. Pilots holding a green certificate could fly in worse weather conditions with fewer restrictions. The two categories of pilots were necessary because of the diversity of flight instruments.

In addition to being challenging to get used to, the new 1944 program revealed the problems of the mid-war era. For the pilots to be able to participate in the war in big numbers, they had to have the certificate as soon as possible from the moment they arrived at the unit. The condition for using flight instruments only with a green certificate has been revoked. Another change was the replacement of the written exam with an oral one, and commanders were primarily responsible for issuing certificates in their units. Students continued their wartime training with an emphasis on flight instruments.

The 1945 instrument-training syllabus contained 37 hours of flying and 25 hours spent in the Link Trainer, which was very similar to that of 1942 but improved to make the training more effective. Each instructor was required to complete 15 flying hours, 10 with the Link Trainer, and 25 classroom hours. Ground instrument training schools became routine, and in 1945, 30 hours of this training were introduced. The training also became more intense, so the cadets had an hour of instrument flying daily.

The training increased significantly in 1947, reaching 270 hours, but it was much better organized than during the war. Although the training has improved, only two stages remain beginners and advanced. Fifty-five hours were devoted to instrument flight, more precisely 20% of the total, and 40 hours were dedicated to the Link Trainer. Ninety-five was the maximum number of hours awarded until then for instrument flight.

Four differences made the 1947 curriculum effective: instrument flight was considered a basic concept to be taught, simulators were important elements for cadet training, and the altitude indicator was the basis of flight instruments.

CONCLUSIONS

The historical evolution of instrument flying within the Army offers insightful lessons on integrating technological advancements into military operations. This journey demonstrates that creating a crucial military capability involves more than just getting and using technology, it's a complex process that goes beyond simple acquisition and deployment. A multitude of factors, including operational demands, organizational culture, financial constraints, and the indispensable contribution of skilled personnel, shape it.

In the past, the Army dedicated extensive periods, sometimes up to three decades, to refine and perfect essential combat skills like instrument flying.

This process was not merely about embracing a new technology but involved a comprehensive and iterative process of adaptation, training, and continuous improvement to meet the evolving demands of warfare. Such a deliberate and prolonged development period underscored the complexity of achieving operational proficiency and technical mastery in the military.

However, the contemporary military landscape is marked by rapid technological change, pressing the armed forces to identify and integrate indispensable technologies swiftly. This shift has made the long timelines from the past impractical. Yet, the fundamental influences that dictate the success of technological integration, operational requirements, the mindset within the organization, budgetary allocations, remain as relevant today as they were during the development of instrument flying capabilities.

The Army's journey with instrument flying serves as a powerful reminder of the challenges and factors involved in improving military capabilities. It shows that achieving real expertise and readiness in using new technologies goes beyond just having innovative tools; it calls for a strategic approach to dealing with these ongoing factors. This strategic approach involves recognizing the potential of a new technology and investing in the training, adaptation, and continuous learning necessary to fully realize its benefits.

As the military navigates the persistent challenge of identifying and deploying critical technologies in a rapidly evolving landscape of innovation, the insights gained from the evolution of instrument flying provide invaluable guidance. They underscore the importance of a well-rounded and nuanced strategy beyond simply acquiring technology, emphasizing the necessity for patience, creativity, and concerted effort to establish sustainable and effective military capabilities.

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UNDERSTANDING MULTI-DOMAIN OPERATIONS FROM THE AIR FORCE PERSPECTIVE

George–Adrian AIONESEI[*], Cristian PANAIT[**]

[*]Boboc Air Force Base, Buzău, Romania (aioneseiadrian11@gmail.com),
[**]"Henri Coandă" Air Force Academy, Braşov, Romania (cripanait@gmail.com)

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Abstract: *This document delves into the transformative shift in military strategy towards Multi-Domain Operations, dictated by the fast evolution of warfare technologies and the complex nature of the contemporary battlefields. It outlines the historical progression of warfare from domain-specific tactics to the integrated approach of MDOs, emphasizing the importance of synchronizing operations across land, air, sea, space and cyberspace to achieve operational superiority. The air force's critical role in this paradigm is highlighted, including its capabilities in air and space superiority, intelligence, surveillance, reconnaissance, rapid global mobility, and command and control. There are also discussed the challenges such as interoperability, technological adaptation and training for MDOs, as well as the future success of military operations which fosters collaboration and innovating training programs to effectively counter adversaries in this new era of warfare.*

Keywords: *multi-domain, air force, warfare, operations.*

1. INTRODUCTION

One of the main reasons to change the way military forces conduct their operations, either offensive or defensive, is based on the changes that take place at the technology and maneuver levels. When a new technology is involved in the battlefield, the tactics, techniques, procedures and ultimately the doctrines have to be changed accordingly in order to have the advantage over the enemy.

Looking back, hand-to-hand combat was a defining feature of early warfare, with methods and tactics frequently constrained by weapon technology and soldier physical prowess. As civilization advanced, so did the military technology and organizational systems, leading to evolution of specialized units such as cavalry and archers.[1] Then, the introduction of gunpowder in the warfare, and the rise of artillery and infantry equipped with firearms transformed the way of battles, sending the troops into the trenches [2]. This became the time of modern armies as permanent and professional establishments and the development of navy and maritime battles.[3] The next important episode in the warfare evolution consists of the Industrial Revolution, which brought important advancements in weaponry and logistics, enabling mass production of arms and the use of large-scale forces into the battlefield. The power of modern industrialized warfare was demonstrated in World War I and World War II with new technologies such as tanks and aircrafts, innovations that rapidly changed the nature of conflict.[1] The Cold War and the Nuclear Age, another shift in the warfare, focused on the nuclear arms race and a strategy of deterrence between big states. As a result, based on the threat of mutual destruction, the international relations were reshaped. The conventional forces were not

eliminated, but the attention was shifted more towards strategies of potential global annihilation.[4] The last important stage of technology advancement lays in the information age and the network-centric warfare in the late 20th century, which reduces the classic physical warfare and emphasizes the power of information in order to boost situational awareness, speed of reaction and command, and the ability to be more precise and efficient. The development of the satellite communications and surveillance made it possible for space-based capabilities to be integrated within traditional military operations.[5]

Each historical phase demonstrates an incremental move towards the principles that laid the foundation for how the military operations are conducted today. The shift from separated domain-specific tactics to integrated multi-domain strategies shows the continuous adaptation of military thought to take advantage of communication and technological breakthroughs, reflecting the complexity of contemporary international warfare.

2. MULTI-DOMAIN OPERATIONS

Having in mind how the technology has changed the history through some important milestones, those milestones in their turn, had their contribution to the ways in how the wars were organized and conducted from the strategic point of view. At first, the land and sea domains were seen as the main means through which the military, political and economic powers were projected in the battlefield. The fast advancements in aviation led the air domain to become equal as importance to land and maritime domains in operations such as The Blitz (1940-1941), The Berlin Airlift (1949) or Operation Desert Shield and Desert Storm (1991). Many military campaigns, since World War I, have been carried successfully with an effective and powerful collaboration between the three domains [6].

With the base of the pyramid formed, it was only a matter of time until a new domain will take place in the warfare spectrum: the space power. Gulf War (1990-1991), the invasion of Afghanistan in 2001 and the invasion of Iraq in 2003 were some occasions where all four fields were put together, with the space having a special contribution [7]. The last domain that closed the circle was cyberspace, a domain that was firstly used with 2010 Stuxnet, the first genuine cyberweapon designed to inflict physical damage, which ruined almost 20% of Iran's nuclear centrifuges [8]. Even though space and cyberspace present a few limitations regarding geography, these five domains that drew their attention through time, complete the operational environment for which military experts and leaders must prepare in the current century. This environment refers to the new concept introduced by the United States of America Army in 2018, as Multi-Domain Operations (MDO). The future conflicts will not be restricted to single domains (land, sea, air), but will encompass other areas such as space, cyberspace or electromagnetic spectrum. It reflects an understanding of the complex and interconnected battlefield of the current century, where military warfare goes asymmetrical with the possibility of battles in multiple arenas.[1]

The full definition of the term Multi-Domain Operations (MDOs) has not reached its final stage, as many states or entities have different ways of defining it. The terms "multi" (multiple) or "operations" do not represent a matter as to what they signify, but the issue becomes more complex when military professionals try to agree on the meaning of the term "domain". This term has multiple connotations outside of the military environment; therefore, the military is in the position of not only clarifying the meaning of the word itself, but to ensure the definition is different from the usage outside the military context.

A definition proposal that was accepted by many is the one the director of Multi-Domain Operations Strategists concentration of the US Air Forces Air Command and Staff College, Jeffrey Reilly gave, such as a "domain is a critical macro maneuver space whose access or control is vital to the freedom of action and superiority required by the mission" [9]. Simply put, a domain represents an accessible area, which is not necessary to be physical, where there can exist modifications.

The definition of MDOs is an issue highlighted by the differing terminologies and concepts used within and among NATO allies. The U.S. Department of Defense (DOD) officially adopts the term JADO (Joint All Domain Operations) [10], while the U.S. Army refers to it as MDO. Canada prefers the term pan-domain operations [11] whereas other NATO members and NATO itself generally use MDO. In The US Joint Publication 3-0 (JP 3-0), MDO takes the form of Operational Environment which encompasses physical areas of land, maritime air, space and cyberspace as well as the electromagnetic spectrum and involve conventional, special operations, ballistic missile, electronic warfare and information capabilities [12]. In the US Army Multi Domain Operations 2028 document, the term MDOs is defined as "operations conducted across multiple domains and contested spaces to overcome an adversary's strengths by presenting them with several operational and/or tactical dilemmas through the combined application of calibrated force posture" [13]. For the Nord Atlantic Treaty Organization (NATO), as its core, MDO refers to the push for the organization to orchestrate military activities across all operating domains and environments. These actions are synchronized with non-military activities and enable the Alliance to create desired outcomes at the right time and place [14]. It effectively frameworks the leaders of NATO vision towards military and political levels for an adaptable, MDO-enabled alliance capable to outsmart and outpace the enemies.

The crucial first step requires a careful understanding of the elements of the operational environment and the relations between them, which makes possible the cross-domain synergy.[15] As stated in the JP 3-0, an operational environment consists of two big elements, the five physical domains: land, maritime, air, space, cyberspace (which transits the other four domains through nodes encompassing both civilian and military entities) and the three dimensions: physical, information, human, which can be analyzed at the level of each individual domain [12]. If commanders and staff are able to understand the physical, information and human dimensions corresponding to all domains, they have the advantage to asses and anticipate the impacts of their operations. A representation of these domains and dimensions is illustrated in Fig. 1.

Understanding each domain and dimension is crucial for developing comprehensive military strategies that leverage the full spectrum of capabilities in contemporary conflict environments.

Domains in MDOs:

- **Land** – this domain is the traditional sphere of military operations, involving securing territory, controlling population centers and engaging with enemy ground forces. Its complexity has increased with the advent of urban warfare and asymmetric threats, requiring a continuous adaptation;

- **Maritime** – this domain includes the world's oceans, seas and waterways, and the maritime operations focus on securing sea lines of communications, projecting power ashore and denying adversaries the use of maritime routes. It is essential for the movement of military forces and equipment;

- **Air** – it encompasses the airspace above the land and sea, including aircraft, satellites and associated infrastructure, and enables the projection of power, rapid mobility of forces, intelligence, surveillance and reconnaissance capabilities and direct support to ground and sea forces;

- **Space** – it includes the area above the Earth's atmosphere where satellites operate and provides critical capabilities such as communication, navigation, early warning systems and intelligence, surveillance and reconnaissance (ISR);

- **Cyberspace** – this domain has the global network of information technology infrastructures, including Internet, telecommunications network, computer systems. The operations in cyberspace can influence the outcome of conflicts in other domains by disrupting enemy communications, gathering intelligence, and manipulating information.

Dimensions in MDOs:

- **Physical** – this dimension refers to the tangible aspects of military operations, including personnel equipment, infrastructure, and the geographic environment. This dimension is closely associated with traditional concepts of warfare but is increasingly integrated with actions in the information and human dimensions;

- **Information** – it encompasses the collection, management, protection and dissemination of information. It includes cyber operations, electronic warfare, and psychological operations aimed at influencing, deceiving, or disrupting the enemy's decision-making processes.

- **Human** – it focuses on the influence of operations on human behavior, beliefs, and decision-making. This includes the morale of forces, the support of local populations and the perceptions of the international community.

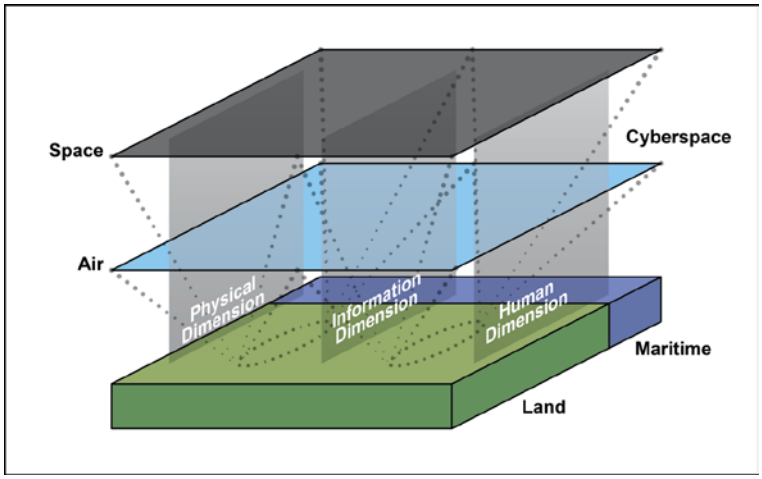

FIG. 1. Domains and dimensions of an operational environment (1) – FM 3-0-000

3. TAKEWAYS FROM THE RUSSIA-UKRAINE WAR

Since February 22nd 2022, when Russia began the invasion of Ukraine, the multitude and continuous military operations constituted an uncertainty of what would happen next. This ambiguous "fog of war" of what is occurring during combat could be considered an important factor [16], and even though the future of war cannot be exactly predicted, this conflict holds a series of lessons for NATO on how to adapt and integrate MDOs.

The conflict has highlighted the pivotal role of the cyber domain in modern warfare, demonstrating that cyber resilience and offensive capabilities are essential components of national defense strategies. Even before the invasion on February 2022, Russia used cyberattacks against Ukraine, focusing on distributed denial-of-service (DDoS) on websites across multiple sectors, including one of the Ukrainian Ministry of Defense on February 15th [17], or sending wiper malware programs to erase data, programs or hard drives, to the main institutions of government, financial, information technology and energy sectors [18]. Also, the Ukrainian Internet services were temporarily affected in

aimed attacks to telecommunication systems [19]. Besides disruption and disruptive attacks, data weaponization (acquisition of data for espionage, surveillance and intelligence purposes) and disinformation were used before and after the invasion [20]. The cyber resilience that Ukraine inflicted against Russian attacks was critical for military, as well as for the economy and civilian part. The key for success laid in the high degree of collaboration between other nations governments and public institutions [21].

One of the main lessons that can be derived from this is that the cyber element, as part of MDOs, is able to connect kinetic and cyber operations. Just before the conventional invasion by Russia on land, the cyberattacks on computers, modems that communicate with satellites, or networks, were a great distraction for Ukrainian forces and for its command and control. A second outdraw consists of the participation of non-traditional actors engaged in cyberattacks [22]. After the attack on satellite communications infrastructure, because the Ukrainian military and government could not use the satellite communications anymore, SpaceX offered free access to their network, Starlink satellite Internet services. The replacement was welcomed and used as primary network, proving to be resilient against signal jamming too [23].

On another level, a main characteristic of the Russia-Ukraine War since the beginning of it has been the utilization of Unmanned Aerial Systems (UAS) on the battlefield. The use and advancement of UAS have highlighted broader trends in drone technology and its integration into high-intensity conflicts of contemporary battlefield. The Unmanned Aerial Vehicles (UAVs) were present since the early stages of the war. Ukraine used the Bayraktar TB2, whilst Russia used Kronshtadt Orion, Korsar and Forpost-R. The use of these types of drones was mainly for ISR, and electromagnetic warfare (EW) as well as precision strikes, but in time, they showed to be expensive and unreliable in enemy's airspace as the air superiority could not be achieved through them [24]. Therefore, both parties searched for alternatives and the solution was to have smaller and more cost-effective UAVs, rather than big and easier to target drones. The drone dynamics in Ukraine have showed class I (less than 150 kg) and class III systems (greater than 600 kg). While large drones equipped with missiles can cause significant destruction in scenarios where air superiority is established, smaller drones were becoming essential for providing ground troops and mobile units with critical situational awareness. Moreover, small and inexpensive "kamikaze" drones offered an alternative method for delivering explosive payloads [25]. Another utilization of drones over the last two years is that both Ukraine and Russia managed to integrate UASs in their command-and-control organizations through the "kill chains" concept – a process of understanding the battlefield, identifying a target, determining the target's location, deliberating what action to take and deciding the best course of action for gaining the advantage [26]. Even though the EW was used and prevented the ISR mission, both parties managed to gather the needed information in order for the military leaders to know the battlefield and to make their decisions accordingly.

The use of UASs in the Russia-Ukraine conflict underscores their strategic and tactical significance across all domains of warfare. Their flexibility, cost-effectiveness and capability to operate in high-risk environments make them indispensable tools in achieving multidimensional operational objectives. While UAVs are being used in the conflict on multiple fronts, they are expected to have a critical role in the future for both Russia and Ukraine. Thus, the battlefield will become the main source of ideas for the development for new and more efficient drones for future conflicts [27]. As the conflict progresses, the evolving use of UAS will likely continue to shape the tactics and strategies employed by both sides, showing the critical role of unmanned systems in contemporary and future warfare scenarios.

The conflict between Russia and Ukraine might be far from over, but besides the negative effects that brings to both countries and also to the entire world, it shows evolution on different domains and ways of how to approach the current and future warfare. NATO as an alliance and all the nations at the individual level are able to learn from this conflict how to integrate critical factors into their defense systems and how to manage a possible confrontation with a belligerent. Also, the takeaways from this conflict and others can help to shape the MDOs to the point it does not raise any concern on its definition or how it can be applied in the warfare.

4. AIR FORCE AND MULTI-DOMAIN OPERATIONS

Besides the Russia-Ukraine war, by looking at the global campaigns there can be analyzed the possibilities of how the components of MDOs can be related and used in order to be central for every operation. For example, if there is a military engagement of NATO with Russia, there will be mainly an air, space and land campaign with the help of the maritime component. If there is a campaign in the Pacific, mainly it will be a maritime, air and space campaign with a small implication of the land element. For a Middle East campaign, there will be the air and space elements first, after which the land and maritime components will enforce the operation. What it can be withdrawn from these examples and from the military events that were conducted in the past, is that the air and space components (once considered as one element) are the ones that need to be present and engaged in most of the military operations either small or regional to global ones.

Air forces, at the global level undertake a diverse range of operations beyond the traditional domain of air combat to strengthen regional stability and address security challenges. The core missions of air forces encompass air and space superiority, ISR, rapid global mobility, global strike, and command and control (C2). Every nation and alliance that possesses an air force, defines its role and tasks clearly in order to create a safe air space for itself and for the allies. NATO Joint Air Power has a key role in accomplishing its three main tasks: collective defense, crisis management and cooperative security, through its three main attributes: speed, reach and height. The alliance is faced with threats and challenges, from either state or non-state actors (Russia, China), terrorism, and cyber-attacks, which are more complex nowadays. As air and space overlay the globe, the organization must be able to employ air power in all possible terrains and environments [28].

For another instance, the Royal Air Force (RAF) is involved in multiple operations across the globe, highlighting the importance of air forces in preserving stability and assisting allies on a global scale. Important RAF activities include the establishment of the UK Space Command to defend space domains, support for the COVID Aviation Task Force in the UK, and Operation SHADER against Daesh in Iraq and Syria. In order to improve coordination and readiness among NATO partner countries, the RAF also takes part in a number of exercises, such as Exercise Point Blank alongside the US Air Force and NATO Air Policing missions in the Eastern side of Europe [29].

In addition to these operations, the Air Force Global Strike Command (AFGSC) highlights the strategic capabilities of the U.S. Air Force, overseeing all long-range nuclear-capable bomber and intercontinental ballistic missile forces. This includes managing bombers like the B-52 Stratofortress, B-1 Lancer, and B-2 Spirit, which are essential for global strike capabilities and deterrence strategies [30].

In MDOs, the air force’s role is pivotal as it moves towards a fully networked, integrated approach to modern warfare, where victory hinges on the cohesive operation of

networks, sensors, and systems across air, space, sea, cyber and information domains. General David L. Goldfein, the 21st US Air Force Chief of Staff, emphasized that the future of combat would depend less on individual platform capabilities and more on the integrated strengths of a connected network. The Air Force aims to create a force where every asset is interconnected, transforming the way information is collected, assessed, and transmitted, thereby producing multiple dilemmas for adversaries to overwhelm them [31]. He also suggested that MDOs would change the character of warfare by utilizing dominance in one or many domains to create overwhelming challenges for adversaries and find their vulnerabilities.

As a general aspect, the main contributions that the air force can bring to its domain in order to create a secure and efficient environment when it comes to MDOs consist in:

- Rapid global mobility and reach;
- Air superiority and space control;
- Intelligence, Surveillance and Reconnaissance (ISR);
- Precision strike capabilities;
- Command and control (C2);
- Adaptability and innovation;

The air force's role in MDOs is multifaceted, usable cross-domains and by leveraging its strengths and integrating with other services and allies, it significantly contributes to the effectiveness and success of MDOs. Until the point where MDO can be utilized at its full potential, integrating in the most efficient ways all domains with all their characteristics, in order to complete an objective flawlessly, military and political experts also need to analyze the barriers that might be encountered along the way and also the future implications that the air forces have to face.

5. CHALLENGES AND FUTURE IMPLICATIONS OF AIR FORCE IN MDOs

MDOs might be considered a shift from traditional joint operations towards operations that leverage capabilities across multiple domains simultaneously, demanding significant adaptations in command and control, connectivity, interoperability, technology and training.

Interoperability and technology play critical roles in enabling MDOs, requiring robust real-time intelligence sharing among allies. The political will to share data is often a bigger barrier than technical connectivity. NATO allies need to work towards a unified multi-domain strategy, involving political decision-makers in the process to ensure necessary intelligence sharing and establishing a legal framework for operations. This interoperability is essential for creating a common operating picture and ensuring the effectiveness of MDOs across allied nations.

Training and personnel development are also crucial for the successful implementation of MDOs. A bottom-up cultural change in the education and training process of military personnel is required to develop an appreciation and understanding of MDOs. The establishment of a formal cadre for dedicated Multi-Domain Command and Control (MDC2) experts and the development of MDO training infrastructures using live, virtual and constructive training paradigms are steps towards achieving this. Once the MDC2 is formed and effectively used, in order to enable it to a larger scale, the nations and the alliance need to take in consideration the connectivity at the information level. A potential combat cloud might be the solution for centralization of all the information that afterwards can be shared to multiple entities. At the same time, all members could generate more data with their own sensors and systems and update the cloud in real-time. Such measures will enhance decision-making in MDOs and simulate complex threat

environments, preparing personnel for the integrated operational demands of future conflicts [32].

The transition to MDOs involves a few implications that are crucial for understanding the new concepts that emphasizes the inherent cooperation and interoperability within air forces, expanding from traditional airpower to integrating kinetic and non-kinetic effects across multiple domains in real-time [13]. In the future, as shown by the German Luftwaffe, MDO needs to find its place into every nation and alliance's mindset in order to create a desirable advantage over others. This involves embracing the importance of cyber and space, which are crucial to all other domains. Cyber actors can change their environment to both their advantage and their enemies' disadvantage, and space actors have direct contact and access to all traditional domains.

To ensure the success of joint all domain operations (JADO), the C2 must give up the traditional way of thinking and leave behind the well-used and rigid hierarchical command structure at all levels. The air dimension might be the perfect one to provide the tactical part of distributed control if the electromagnetic environment (component of the cyber domain) is well managed across all domains. Multi-domain C2 requires dynamic action at the tactical level, with agile decision making critical to the success of joint all domain integration. In the area of information processing, the C2 needs to take a new approach. The air force can generate an immense amount of data, but the main concern lays in what information should be shared and with whom, to best enable the delivery of the right effect at the right place and time.

Another aspect regarding the application of MDOs in the future refers to the selection of the systems that need development for new needs or requirements and systems that do not fully meet the modern technological requirements or are efficiently enough. As an alliance, NATO's air force should focus on unfolding the full potential by integrating besides the newest technology, older weapons (such as 4^{th} generation fighters – Eurofighter, Rafale, Hornet, Gripen) effectively into the multi-domain concept. For this purpose, the best approach is to participate at as many international exercises, an approach that will focus on multinational cooperation, the basis of interoperability [33].

The last implication for the future of MDOs is of a greater importance, because it is located at the core of the concept. The need of a vision through many small steps can be materialized by sharing information, ideas and theories but also by cooperating in early testing and technology development. These will be achievable by a few short and medium-term approaches that will focus on the best resource that every military forces have: the personnel. Moving forward, education, training and leadership will be the key to train the airmen in a multi-domain manner. These will be introduced from the beginning of career and at every step where it is necessary in order to fulfill the long-term vision.

6. CONCLUSION

The evolution of warfare and the beginning of MDOs mark a transformative period in military strategy, where the integration of capabilities across land, air, sea, space and cyberspace domains becomes essential for achieving operational superiority. This comprehensive approach reflects the recognition of the complex, interconnected nature of contemporary battlefields, where traditional domain specific tactics are insufficient. The air force, with its pivotal roles in air and space superiority, rapid global mobility, precision strike capabilities, ISR and command and control, emerges as a central figure in the successful execution of MDOs. Challenges such as interoperability, technology adaptation and the development of a multi-domain mindset underscore the need for enhanced collaboration, innovative training programs, and a forward-thinking approach to harness

the full potential of MDOs. The future of warfare demands a dynamic, agile military force capable of leveraging the synergistic effects of joint domain operations to outmaneuver adversaries. By embracing the principles of MDOs and fostering a culture of continuous learning and adaptation, military forces can maintain strategic advantage and ensure security in an increasingly complex and technologically advanced environment.

The concept of MDOs as a whole and specific to each domain is still in an initial phase. This article aimed to provide a summary of information to lead to a better understanding of the existing bibliography in the field.

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FLIGHT SIMULATOR TRAINING: PSYCHOPHYSIOLOGICAL RESPONSE

Laurențiu-Ioan GĂINĂ, Sorin PARASCHIV

Boboc Air Force Base, Buzău, Romania (laurentiu.gaina@yahoo.com, sorinparaschiv_atu@yahoo.com)

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Abstract: *Flight simulators have become indispensable in the aviation industry, providing accurate and detailed simulations of cockpit and environmental conditions. They serve a variety of purposes, including pilot training, aircraft design, and accident investigation. While simulators are able to replicate many aspects of real-world flying, there are still differences in stress levels and response intensities. As such, a comprehensive training program that includes both simulated and real-world experiences is necessary to ensure pilots are well-prepared for handling the diverse challenges of aviation operations.*

Keywords: *training programs, simulator, military aviation, mental workload*

1. INTRODUCTION

Flight simulators are essential in various aspects of aviation, including pilot training and maintaining pilot proficiency. Their importance extends beyond these areas including roles in air accident investigations, aircraft design studies, and simulations of air traffic. The increasing complexity of modern aircraft systems drives the integration of simulators into the aviation industry. As aircraft become further developed, simulators have become fundamental for training pilots and developing their skills in a controlled and safe environment. [3,20]

Simulators are of immense value in researching how aircraft could be designed to align better with human capabilities and limitations. This is particularly pertinent in endeavors to enhance safety and efficiency in aviation. The high fidelity with which simulators replicate the pilot's natural working environment makes them indispensable tools not just for training but also for comprehending the dynamics of aircraft and pilot interactions during flights and in critical situations. [3,8]

Using simulators helps bridge the gap between theoretical knowledge and real-world application, providing pilots with experiential learning and decision-making practice without the risks associated with actual flying. Additionally, the ability of simulators to recreate specific flight conditions and emergencies makes them critical for preparing pilots for various scenarios, thereby improving overall aviation safety. [1,19]

2. GENERAL CHARACTARESTIC

The evolution of flight simulators from their inception to modern equivalents represents a transformative journey in aviation training technology. Initially, flight simulators like the "Aeronautical Link Trainer" offered a rudimentary platform with limited cockpit instruments and no external environmental simulation.

However, today's simulators have revolutionized pilot training, providing high-fidelity recreations of both internal and external aspects of flight missions, complete with advanced motion simulation platforms. These modern simulators are not just tools, but the backbone of pilot training and professional development, their role being significantly influenced by factors such as safety, cost-efficiency, technical attributes, and training methodologies. [4,14,15]

Modern flight simulators serve as more than just educational tools. They are practical aids, demonstrating specific procedures and the use of aircraft systems, which effectively reduce the discrepancy between theoretical knowledge and practical application. They also cultivate practical skills and desirable personality traits in pilots, preparing them for high-pressure situations and unfamiliar challenges. Moreover, simulators play a central role in assessing pilot behavior, validating theoretical concepts, selecting suitable candidates, and conducting exams for aviation certifications. These functionalities underscore the simulators' versatility and necessity in pilot training programs, providing a reassuring sense of preparedness for real-world scenarios. [14,15]

Furthermore, the design of flight simulators is a complex process that integrates cutting-edge technology and a deep understanding of human factors, such as cognitive capabilities and information processing. This process is crucial in developing a pilot's ability to automate routine cockpit actions, which enhances focus on critical scenarios requiring quick decision-making. The realism of simulators, especially in replicating the aircraft's controls and the mission environment, is vital for practical training. Therefore, the need for pilots to exhibit initiative and perform specific actions automatically becomes even more critical. [14,15,18]

The historical context reveals that until the mid-1970s, flight simulators were often seen more as novelties than essential training tools within civil aviation. However, perceptions changed as the benefits of simulator training became evident, particularly during the oil crisis of the 1970s when simulators emerged as a cost-effective training alternative. Today, they are an integral part of aviation training, essential for advanced training and the basic training of new pilots, reflecting their enduring importance in the ongoing development of the aviation industry. [11,17]

3. MENTAL WORKLOAD

Mental workload is the amount of capacity required to perform a task. It is essential in evaluating system design, mission, and training in aviation. Mental workload is a precursor to performance and is influenced by uncontrollable circumstances, leading to variations. The interplay between mental workload, situation awareness, and performance has been studied in various settings, and it is clear that an increase in mental workload leads to a decrease in situation awareness and performance. [16]

A research project was conducted at the F17 Air Force Wing in Kallinge, Sweden, to examine five male fighter pilots' psychophysiological responses and evaluations during simulated and actual flights. Each pilot completed the same air-to-ground mission in a simulator and three times in a real aircraft. The mission was divided into four stages: flying to the target area, a high-speed, low-altitude pre-attack phase, an attack phase involving a pop-up maneuver and weapon deployment, and a disengagement phase returning home. The simulator and actual flights utilized the same scenario, tactics, and type of aircraft—a JA37 "Jaktviggen". Although this model was operational at F17 in 2002, it has since been replaced by the JAS39 Gripen. The simulator, crafted from an obsolete aircraft, featured a realistic cockpit and an immersive visual environment.

However, its motion simulation capabilities were deactivated during the study, so there was no motion feedback. Measurements of heart rate, heart rate variability, and eye movements were recorded with a portable device. Additionally, pilots assessed their mental workload, situational awareness, and performance in both settings. The psychophysiological data were standardized to highlight pilot commonalities, discounting individual variations. [5,9,7]

The outcomes from the psychophysiological measurements indicate no significant differences in the participant's responses in the simulator versus actual flight. Both settings showed a marked increase in heart rate, a decrease in heart rate variability, and a reduction in eye movements at the moment of weapon deployment, as depicted in Fig. 1. The similarity in psychophysiological reactions between simulated and actual flights was strikingly high, particularly for heart rate and heart rate variability. The correlation in eye movements was also strong, albeit slightly less so. [9]

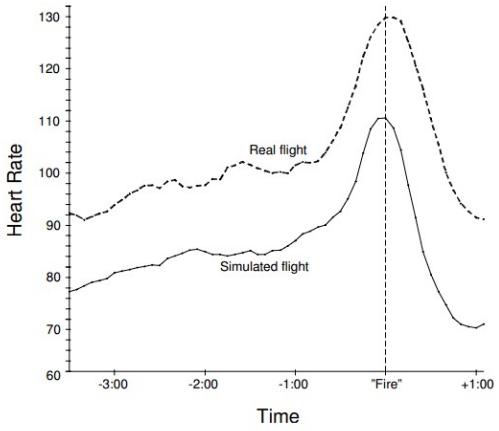

FIG. 1. Comparison between psychophysiological reaction during simulated and real flight

While the overall patterns of psychophysiological responses were similar, there was a noticeable difference in intensity; participants exhibited a higher heart rate when piloting the real aircraft than the simulator. [5,9]

The findings also reveal a variation across the three iterations of the mission. The first sortie produced a higher heart rate in both simulated and real flights than the subsequent two, as illustrated in Fig. 2. [5,9]

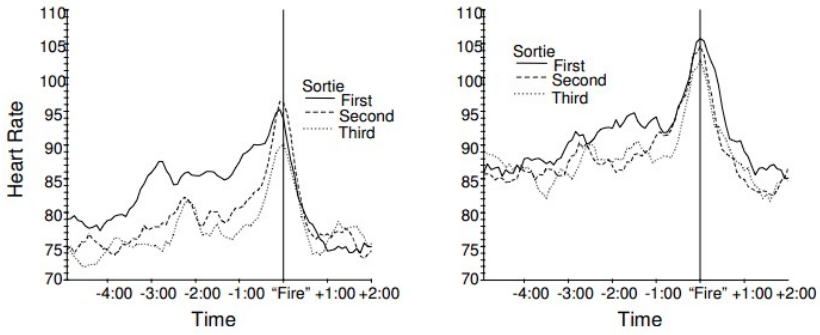

FIG. 2. Heart rate across three consecutive flights: simulated flights on the left, real flights on the right.

Although there is a primary effect based on the type of flight (simulated or actual), there is no interaction between the type of flight and the time (or sortie).

This indicates that the reactions did not differ between simulated and real flights or between sorties despite a variance in intensity. Statistically, the response curves are parallel. Like heart rate, heart rate variability also follows a consistent pattern, as shown in Fig. 3. In both simulated and real flights, the first sortie displayed lower heart rate variability than the latter. [5,9]

Although a main effect exists for the type of flight (simulated or actual), there is no interaction between the type of flight and time (or sortie). This indicates that despite differences in levels between simulated and real flights (and among sorties), the response curves remain parallel, demonstrating very similar pilot reactions. [7]

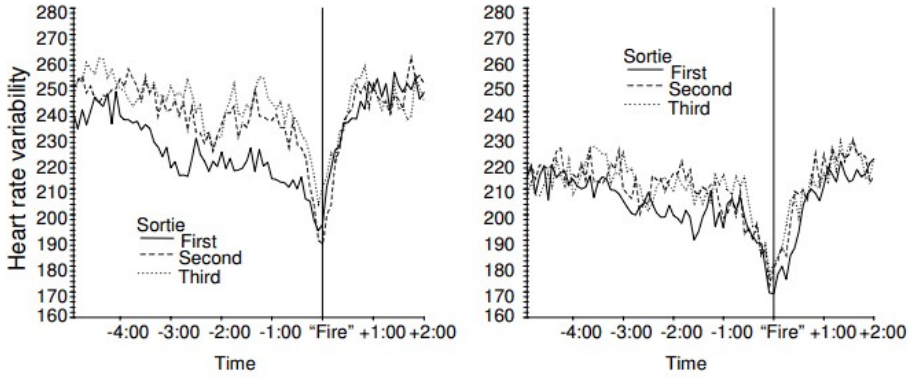

FIG. 3. Heart rate variability across three consecutive flights: on the left are the simulated flights, and on the right, the real flights. The vertical scale is arbitrary

Eye movement data also indicate a high degree of similarity between simulated and real flights, as shown in Fig. 4. [2,9]

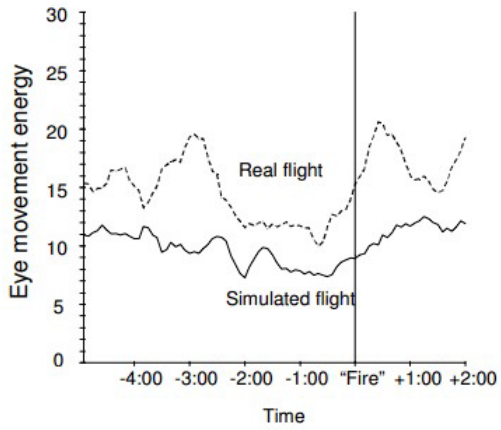

FIG. 4. Eye movement energy in simulated and real flight

During the attack phase, when weapons were deployed, participants reported the highest levels of mental workload, coinciding with their peak heart rates, as illustrated in Fig. 5. The correlation between these two measures was relatively strong. [9,10]

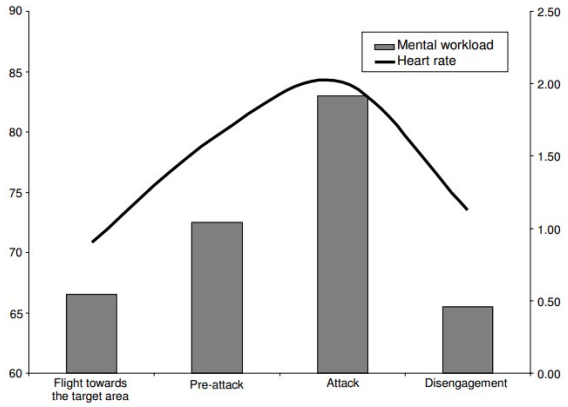

FIG. 5. The similarities between heart rate (scale on the left side) and ratings of mental workload (scale on the right side)

The relationship between mental workload, heart rate, situational awareness, and performance is depicted in a diagram, as shown in Fig. 6. The model illustrates that an increase in mental workload corresponds with an increase in heart rate and a decrease in situational awareness, which in turn leads to a decline in performance. [10]

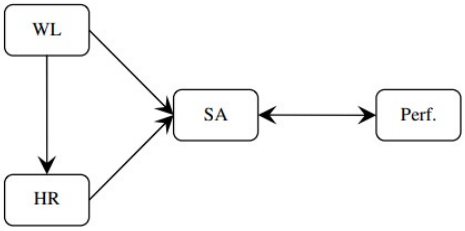

FIG. 6. Diagram describing the relationship between Mental Workload (WL), Heart rate (HR), situation awareness (SA) and performance (Perf)

After analyzing the similarities and differences in psychophysiological reactions between simulated and real flights, some noteworthy findings were discovered. It was observed that the increase in heart rate during similar flight phases is consistent across both simulated and real flights, which is valid for all psychophysiological measures observed. However, there were also significant differences; the heart rate was consistently lower in the simulator, heart rate variability was higher, and eye movements were reduced compared to actual flights. [9,10]

Furthermore, the relationship between psychophysiological data and self-reported mental workload was explored, revealing that variations in these measures could be integrated into a statistical causal model. Particularly, heart rate was found to closely correlate with the ratings of mental workload, highlighting its potential as a predictive indicator of psychological stress during flight operations. This thorough analysis helps in comprehending the effects of simulation versus actual flight conditions on pilot performance and physiological responses. [7,9,10]

CONCLUSIONS

The assessment of mental workload presents a comprehensive approach to evaluate flight simulators' training potential, focusing on user experience rather than just technical specifications. It is important to note that a high mental workload does not always equate to effective training, as excessively high workload situations can hinder learning and have

a negative impact on the overall training process. To enhance training outcomes, it is decisive to analyze the differences between simulated and real flights.

Interestingly, pilots tend to exhibit similar responses to specific events, whether in a simulator or an actual aircraft, indicating that simulators can replicate real flight experiences to a significant degree. Comparable increases in heart rate under both conditions further support this conclusion, demonstrating that practical training can occur in simulated environments.

In conclusion, flight simulators are essential tools in the aviation industry, providing significant benefits in training, safety, and cost efficiency. However, they cannot fully replicate the nuances and intensities of real flying, highlighting the importance of a balanced training approach that combines simulated and real-world experiences. This approach ensures that pilots are thoroughly prepared for all aspects of flight operations.

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THE AMBIGUITY OF LEADERSHIP STYLES: A PSYCHOLOGICAL PERSPECTIVE

Cristian PANAIT

"Henri Coandă" Air Force Academy, Braşov, Romania (cristian_pnt@yahoo.com)

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Abstract: *Leadership is a multifaceted process that involves guiding, influencing, and directing a group toward common goals. Ambiguity in leadership styles arises due to the complex interaction of personality traits, situational factors and the dynamic nature of human interactions. This article examines the psychological underpinnings of leadership, exploring how different styles can be adopted and the impact of those styles on both leaders and followers. Based on various psychological theories and empirical studies, this article aims to provide a comprehensive understanding of the nuances and ambiguities inherent in leadership styles and an argument for a leaders adaptability and authenticity which are not mutually exclusive, but can be complementary when properly managed.*

Keywords: *leadership styles, ambiguity, adaptation, authenticity*

1. INTRODUCTION

Leadership has been a subject of interest in various disciplines, including psychology, sociology, and organizational studies. This paper is part of a broader research I carried out during master's thesis at National Defense University "Carol I" – Bucharest, Air Command and Staff College, with the title "The act of military command. The correlation between personality and leadership styles". During this study, I observed that the majority (over 50%) of subjects (high-ranking Air Force officers with extensive leadership experience) had a high degree of ambiguity when determining the leadership style most characteristic of them.

The ambiguity of leadership styles often results from the dynamic interaction between a leader's personality, the context in which he leads, and the needs of his followers. This article explores these ambiguities from a psychological perspective, examining how different leadership styles emerge and evolve in response to different factors.

2. PERSONALITY TRAITS AND LEADERSHIP STYLES

Personality plays a crucial role in shaping leadership styles. The Five-Factor Model (FFM) of personality, also known as the Big Five, includes dimensions of openness, conscientiousness, extraversion, agreeableness, and neuroticism. Research has shown that these traits can significantly influence leadership behavior and effectiveness.

- **Extraversion**: Extraversioned people are often perceived as charismatic and assertive, making them more likely to adopt transformative leadership styles. They are skilled at inspiring and motivating followers, encouraging a sense of vision and purpose.

Studies such as those by Judge [1] have demonstrated that extraversion is strongly linked to the occurrence and effectiveness of leadership.

- **Consciousness**: Leaders with high consciousness tend to be organized, reliable, and goal-oriented. They can move toward transactional leadership, focusing on clear structures, rewards, and performance management. Conscious leaders are often effective at setting clear expectations and maintaining high standards, as noted by DeRue [2]
- **Openness to experience**: Leaders who score high on openness are usually creative and open to new ideas. This trait can lead to innovative and adaptive leadership styles, encouraging followers to explore new possibilities and embrace change. Research by Lim and Ployhart [3] supports the link between openness and driving efficiency in dynamic environments.
- **Agreeableness**: Agreeable leaders are compassionate and cooperative, often adopting a participatory or servant leadership style. They prioritize the well-being of their followers and strive to create a harmonious and supportive environment. The study Judge [1] conducted also highlights the positive impact of agreeableness on leadership effectiveness.
- **Neuroticism**: High levels of neuroticism can negatively affect driving effectiveness. Leaders who exhibit high levels of neuroticism may struggle with stress and decision-making, which can lead to inconsistent or authoritarian leadership behaviors. Empirical evidence suggests that lower levels of neuroticism are associated with more stable and efficient conduction.

3. SITUATIONAL FACTORS AND LEADERSHIP STYLES

The context in which leadership takes place is another critical factor contributing to the ambiguity of leadership styles. Situational Leadership Theory (SLT) states that effective leadership depends on the training and competence of followers and the specific demands of the situation.

Follower readiness: SLT suggests that leaders need to adapt their style according to the level of development of their followers. For example, directive leadership may be necessary for inexperienced followers, while a more delegative approach may be effective for highly skilled and autonomous individuals.

Environmental context: The nature of the task, organizational culture, and external pressures can also influence leadership styles. In situations of great stress or crisis, a more autocratic style may be necessary to ensure swift and decisive action. Conversely, in a stable environment, a democratic or laissez-faire approach might be more appropriate.

Cultural influences: Cultural norms and values shape the expectations and behaviors of leaders. For example, in collectivist cultures, leaders may emphasize group harmony and consensus, while in individualistic culture, leaders may focus on personal achievement and autonomy. The GLOBE study by House [4] provides ample evidence of how cultural dimensions affect leadership styles.

Leadership is not static, it evolves over time as leaders and followers interact and as situations change. This dynamic nature contributes to the ambiguity of leadership styles, as leaders must continually adapt to new challenges and feedback.

Transactional-Transformational continuum, Bass and Avolio's [5] Full Range Leadership Model describes a continuum from transactional to transformative leadership. Effective leaders often exhibit behaviors from both ends of the spectrum, depending on the needs of their followers and context. This fluidity allows leaders to balance task-oriented and relationship-oriented behaviors.

Leader-Follower Exchange (LMX) Theory [6], LMX theory emphasizes the quality of the relationship between leaders and followers. High-quality LMX relationships are characterized by mutual trust, respect, and loyalty, leading to more adaptable and flexible leadership styles. Leaders with strong LMX relationships can better understand and respond to the needs of their followers.

Authentic Leadership: Authentic leadership focuses on self-awareness, transparency, and ethical behavior. Authentic leaders are true to their values and principles, which can lead to a more consistent and authentic leadership style. However, ambiguity arises as leaders try to balance authenticity with the need to adapt to different situations and followers' expectations.

4. THE PSYCHOLOGICAL IMPACT OF AMBIGUITY ON LEADERS AND FOLLOWERS

The ambiguity of leadership styles has significant psychological implications for both leaders and followers. Understanding these impacts can help develop more effective and adaptive leadership strategies.

Leader stress and burnout: The constant need to adapt and manage different leadership styles can lead to stress and burnout for leaders. Emotional work, the effort to manage and show appropriate emotions, is definitely taxation. Leaders must navigate the tension between showing trust and managing their own anxieties and uncertainties.

Follower satisfaction and performance: Followers perceptions of leadership styles greatly influence satisfaction and performance. Transformative leadership is generally associated with higher levels of motivation and commitment. However, inconsistencies between the leader's behavior and the expectations of followers can lead to dissatisfaction and decreased performance.

Psychological safety: Leadership styles that promote mental safety, in which followers feel safe to take risks and express themselves without fear of negative consequences, are essential for promoting innovation and collaboration. Leaders who can create such environments, despite ambiguity, are often more successful in achieving organizational goals.

To further illustrate the ambiguity of leadership styles, I examined empirical studies and case studies that highlight different aspects of leadership. Some of the examples are:

- Study on leadership flexibility: A study by Yukl and Mahsud [7] found that flexible leaders who could switch between different styles based on situational demands were more effective than those who rigidly adhered to a single style. This flexibility has allowed leaders to better respond to the diverse needs of their followers and react to changing circumstances.
- Case study of Steve Jobs: Steve Jobs, co-founder of Apple Inc., is often cited as an example of a leader with an ambiguous style. Known for his visionary and transformative leadership, Jobs also demonstrated autocratic tendencies, especially when it came to product development and design. His ability to inspire and innovate, combined with his demanding and sometimes tough management style, illustrates the complexity and ambiguity of effective leadership.
- Study of cultural differences: Research conducted by House [4] in the Global Leadership and Organizational Behavior Effectiveness (GLOBE) study demonstrated how cultural differences affect leadership styles. For example, in cultures with a large power distance, authoritarian leadership is more accepted, while in cultures with low distances, participatory leadership is preferred. These findings underscore the importance of cultural context in shaping leadership behavior.

5. BALANCING ADAPTABILITY AND AUTHENTICITY

Dominique Chalvin's (prominent French psychologist and sociologist known for his contributions to the fields of assertiveness training, transactional analysis, and human relations), work on management styles (from the position, role, authority point of view, management in this situation that describes different styles, is the same as leadership) addresses the inherent ambiguity that leaders face in their roles. Chalvin's approach [8] [9] emphasizes the need for flexibility and adaptability in leadership, recognizing that there is no one-size-fits-all solution when it comes to leadership. Some key aspects of how Chalvin describes ambiguity are:

Situational adaptability: Chalvin highlights that effective management, leadership requires adapting to the specific needs of the situation and the individuals involved. This means that a leader might need to switch between different styles—such as authoritarian, participative, or delegative—depending on the context. The ambiguity arises because what works in one scenario might not work in another, requiring continuous assessment and adjustment.

Balancing control and empowerment: Leaders and managers must decide when to exert control and when to empower their team members to take initiative. This balance is delicate and context-dependent, as too much control can stifle creativity and autonomy, while too much freedom can lead to chaos and lack of direction.

Interpersonal dynamics: Chalvin also emphasizes the importance of understanding and managing interpersonal dynamics. Effective managers and leaders need to navigate the complex emotional and relational landscapes of their teams. This involves being perceptive to the varying motivations, conflicts, and needs of team members, which can change over time and require different leadership approaches.

Psychological insights: Drawing from psychological theories, Chalvin suggests that leaders must be aware of their own psychological tendencies and biases, as well as those of their team members. This self-awareness and understanding of others' psychological profiles can help managers tailor their approach to better fit the unique dynamics of their team.

Training and development: Continuous training and development to handle the ambiguities of leadership includes not only technical skills but also soft skills like emotional intelligence, communication, and conflict resolution. By continuously developing these skills, leaders can better navigate the uncertainties and complexities of their roles.

Flexibility and openness: Leaders must be willing to experiment and adjust their strategies based on feedback and changing circumstances. This openness to change helps in dealing with the ambiguous nature of leadership.

The idea of constantly adjusting one's leadership style to fit the team profile and situation is central to effective management. However, this does not necessarily mean that a leader loses authenticity. Instead, adaptability and authenticity are not mutually exclusive but can be complementary when managed appropriately. Research supports the idea that authenticity and adaptability can coexist in effective leadership:

Authentic Leadership Theory, this theory suggests that authentic leaders are those who are self-aware, transparent, and grounded in their values, while also being adaptable to different situations (Walumbwa, 2008) [10]. Authentic leaders are able to balance their true selves with the needs of their followers and the demands of the situation.

Leader – Member Exchange (LMX) Theory, high – quality LMX relationships are based on mutual trust and respect, allowing leaders to adapt their styles without losing authenticity.

Leaders can tailor their interactions to meet the needs of individual team members while maintaining consistent, authentic relationships (Graen & Uhl-Bien, 1995) [6].

5. CONCLUSION

The ambiguity of leadership styles reflects the complex and dynamic nature of human behavior and interactions. From the influence of personality traits to the impact of situational factors and cultural norms, leadership is a complex phenomenon that requires continuous adaptation and self-awareness. By understanding the psychological underpinnings of leadership, we can better appreciate the challenges and opportunities that come with leading others. Effective leadership is not about rigid adherence to a single style, but rather about being flexible, authentic, and responsive to the ever-changing needs of followers and contexts.

Chalvin's theory emphasizes that adaptability and authenticity are not mutually exclusive. Leaders can maintain their authenticity by staying true to their core values and principles while adapting their styles to meet the needs of their team and the demands of the situation. Through continuous development, transparent communication, and self-reflection, leaders can navigate the ambiguities of their roles and lead effectively.

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CONSIDERATIONS REGARDING THE DEVELOPMENT OF A HIERARCHY OF SPECIAL OPERATIONS FORCES WITHIN AIR FORCES USING MULTICRITERIA ANALYSIS

Mihai-Dan DEAŞ

"Henri Coandă" Air Force Academy, Braşov, Romania (mihai_deas@yahoo.com)

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Abstract: *Special operations forces represent an elite element within each military, playing a crucial role in contemporary military operations. Their significance stems not only from the exceptional level of personnel training but also from the quality of equipment and logistic support provided, as these aspects are determinant for the effectiveness and success of the missions they are involved in. In this regard, aircraft and equipment associated with these forces must meet high standards and fulfill stringent requirements, given the complex nature of special operations.*

The article aims to provide readers with an insight into the hierarchy of special operations forces, adopting an analytical approach based on multicriteria methodologies. This methodology allows for the evaluation and comparison of various aspects of special forces, including personnel training, technological capabilities, operational flexibility, and logistical efficiency, to identify and highlight the key elements contributing to the success of these units.

Keywords: *multicriteria analysis, special operations forces, hierarchy*

1. INTRODUCTION

Special Operations Forces (SOF) represent a pinnacle element of modern military capabilities, designed to address and resolve complex and diverse challenges in a dynamic and often hostile operational environment. They constitute a vital component of a nation's arsenal, providing the capacity to act swiftly and effectively across a diverse range of scenarios and environments, often surpassing the capabilities of conventional forces.[1]

These units are trained and equipped to operate in a variety of environments, including urbanized theaters of operations, mountainous, desert, and maritime terrains. Their operational flexibility is a crucial aspect, allowing them to rapidly adapt to the changing requirements and conditions of the terrain and efficiently fulfill their missions.

In this article, we aim to conduct a hierarchy of Special Operations Forces (SOF) through the means of multicriteria analysis. This method enables us to consider essential criteria such as personnel training, available equipment and technology, operational flexibility, logistical efficiency, and previous operational experience.

By combining and carefully evaluating these factors, we can achieve a comprehensive and objective hierarchy of Special Operations Forces. This endeavor not only highlights the strengths and priorities of these units but also provides valuable guidance for their future planning and development, contributing to the strengthening of the capabilities and effectiveness of these elite forces in the face of current and future threats.

Multicriteria analysis represents a strategic methodological approach aimed at conducting hierarchies and prioritizations within the decision-making context. Essentially, this process involves evaluating and comparing multiple alternatives against various relevant criteria, with the objective of identifying and highlighting the most suitable or effective options.

Through multicriteria analysis, the goal is not only to determine which alternatives are superior but also to establish the order of importance based on the defined criteria. This hierarchy is crucial in the decision-making process as it enables the identification and selection of options that best align with the specific objectives and needs of the situation at hand.

To achieve this hierarchy, multicriteria analysis utilizes various techniques and methods, such as the scoring method, which we employed in this study, multicriteria decision analysis, the so-called "consultation group" method, etc. These tools provide a structured and objective framework for evaluating and comparing options based on their diverse characteristics and potential impacts, thereby contributing to more informed and efficient decision-making. [2]

In conducting this hierarchy, the criteria considered are meticulously selected by the study's authors and are primarily based on the characteristics of aircraft used for transporting troops for infiltration. These criteria may include, among others, the aircraft's ability to operate in various weather and terrain conditions, its operational autonomy, as well as the level of safety and security provided to the transported troops. Additionally, another crucial aspect contributing to the hierarchy's development is the infiltration procedure itself, where the type of parachute used to reach the objective can significantly influence the mission's effectiveness and success.

However, within the criteria selection process, special attention is given to a more subjective aspect, namely the combat experience of the special operations forces. The inclusion of this criterion in the analysis is motivated by the recognition of the importance of direct experience in real operations in the effectiveness and adaptability of these forces in conflict situations. However, it is important to emphasize that addressing this criterion is accompanied by increased attention to its subjectivity, given the sensitive nature of the subject and the limitations of information available in the media regarding this specific dimension.

2.MULTICRITERIA ANALYSIS OF FIXED-WING TRANSPORT AIRCRAFT WITHIN THE SPECIAL OPERATIONS FORCES OF THE AIR FORCES

To begin with, we will establish the fixed-wing aircraft in the inventory of special operations forces:

Table 1. Fixed-wing aircraft

Fixed-wing aircraft	**Country**
C-295	Spain
C160 Transall	France
C-130J	United Kingdom
MC-130P	USA
Il-76 Candid	Russia

Once we have established the fixed-wing transport aircraft in the inventory of special operations forces within the air forces of each state, we will initiate the process of multicriteria analysis. Initially, we will define the criteria we consider viable for determining the final ranking. From our perspective, the most important characteristics to be considered, given the purpose of these aircraft, are: maximum takeoff weight, maximum speed, range, engine performance, and finally, maximum altitude.

For this step, we will input the criteria into the table below, along with the indicators and numerical ranges corresponding to each criterion:

Table2. Criteria and numerical range

Criteria		Indicator	Numerical Range
C1	Maximum Takeoff Weight	Kilograme	21.000-195.000
C2	Maximum Speed	Kilometers/hour	480-900
C3	Range	kilometers	1.555-5.000
C4	Engine Performance	kW	2.177*2-7.375*4
C5	Maximum Altitude	Metres	9.145-13.000

Once the criteria, their indicators, and respective value ranges are established, we will create the performance matrix. The rows will represent the criteria, while the columns will represent the fixed-wing transport aircraft alternatives.

Table 3. Performance matrix

Criteria	Maximum Takeoff Weight	Maximum Speed	Range	Engine Performance	Maximum Altitude
C-295[3]	21.000	482	1555	2177*2	9145
C160 Transall[4]	51.000	513	1853	4500*4	8.230
C-130J [5]	70.307	670	3300	3458*4	12.300
MC-130P [6]	70.307	480	5000	3660*4	10.000
Il-76 Candid [7]	195.000	900	4000	7375*4	13.000

The next step involves assigning a scoring range to each criterion considered in the performance matrix, for the purpose of normalizing the matrix and facilitating calculations. The score is in the range of values [1, 3], where 1 represents the least preferred option, 2 represents the average option, while 3 is associated with the most preferred option.

Table 4. The score of each aircraft

Criteria	Maximum Takeoff Weight	Maximum Speed	Range	Engine Performance	Maximum Altitude
C-295	1	1	1	1	1
C160 Transall	2	2	2	2	1
C-130J	2	2	2	2	3
MC-130P	2	1	2	2	2
Il-76 Candid	3	3	3	3	3

Once the scores are established, we need to assign weights to each criterion mentioned up to this point in the development of the multicriteria analysis. In explaining this analysis method, weights are assigned between the values [1, 5], where the values represent: 1 - least important, 2 - somewhat important, 3 - moderate, 4 - important, and finally, 5 - most important. Thus, the weight matrix is created as follows:

Table 5. Directly estimated weights

Maximum Takeoff Weight	Maximum Speed	Range	Engine Performance	Maximum Altitude
5	2	4	3	1

The final step of the fixed-wing transport aircraft analysis consists of solving the calculations and subsequently establishing the final ranking. Following the mathematical calculations, the following values have emerged:

Table 6. The scores of the aircraft

Alternative	Score
C-295	15
C160 Transall	29
C-130J	31
MC-130P	28
Il-76 Candid	45

Once we have obtained the numerical values, we compile the final ranking as follows:

Table 7. The final ranking

Place	The final ranking
1	Il-76 Candid
2	C-130J
3	C 160 Transall
4	MC-130P
5	C-295

3. MULTICRITERIA ANALYSIS OF ROTARY-WING TRANSPORT AIRCRAFT WITHIN THE SPECIAL OPERATIONS FORCES OF THE AIR FORCES

To begin with, we will establish the rotary-wing aircraft in the inventory of special operations forces:

Once the rotary-wing transport aircraft in the inventory of special operations forces within the air forces of each state are established, we initiate the process of multicriteria analysis. The first step is to define the items we consider representative in determining the final ranking. In our opinion, the most important characteristics to be considered, given the purpose of these aircraft, are: troop transport capacity, maximum takeoff weight, maximum speed, range, and finally, maximum altitude.

Table 8. Rotary-wing aircraft

Rotary-wing aircraft	Country
AS 332	Spain
H 225 M	France
Chinook	United Kingdom
Super Stallion	USA
MI-26	Russia

For this step, we will input the items into the table below, along with the indicators and numerical ranges corresponding to each criterion.

Table 9. Criteria and numerical range

Criteria		Indicator	Numerical Range
C_1	Troop Transport Capacity	Number	16-93
C_2	Maximum Takeoff Weight	Kilograme	7.000-56.000
C_3	Maximum Speed	Kilometers/hour	257-327
C_4	Range	kilometers	500-1000
C_5	Maximum Altitude	Metres	4.600-6.100

Once the criteria, their indicators, and respective value ranges are established, we will create the performance matrix. The rows will represent the criteria, while the columns will represent the alternatives of rotary-wing transport aircraft.

Tabelul 10. Performance matrix

Criteria	Troop Transport Capacity	Maximum Takeoff Weight	Maximum Speed	Range	Maximum Altitude
AS 332[8]	24	9150	327	851	5180
H 225 M[9]	16	7000	257	580	4800
Chinook[10]	55	22680	310	740	6100
Super Stallion[11]	93	33339	280	1000	5600
MI-26[12]	90	56000	295	500	4600

The next step involves assigning a scoring range to each criterion considered in the performance matrix, for the purpose of normalizing the matrix and facilitating calculations. The score is in the range of values [1, 3], where 1 represents the least preferred option, 2 represents the average option, while 3 is associated with the most preferred option.

Table 11. The score of each aircraft

Criteria	Troop Transport Capacity	Maximum Takeoff Weight	Maximum Speed	Range	Maximum Altitude
AS 332	1	1	3	2	1
H 225 M	1	1	1	1	1
Chinook	2	2	3	2	3
Super Stallion	3	3	1	3	2
MI-26	3	3	2	1	1

Once the score is determined, we need to assign a weight to each criterion mentioned so far in the development of the multicriteria analysis. Weights are assigned between the values [1, 5], where the values represent: 1 - least important, 2 - somewhat important, 3 - moderate, 4 - important, and finally, 5 - most important. Thus, the weight matrix is created as follows.

Table 12. Directly estimated weights

Troop Transport Capacity	Maximum Takeoff Weight	Maximum Speed	Range	Maximum Altitude
5	3	2	4	1

The final step of the rotary-wing transport aircraft analysis consists of solving the mathematical calculations and subsequently establishing the final ranking. Following the mathematical calculations, the following values have emerged:

Table 13. The scores of the aircraft

Alternative	Score
AS 332	23
H 225 M	15
Chinook	33
Super Stallion	40
MI-26	33

After obtaining the numerical values, we compile the final ranking as follows:

Table 14. The final ranking

Place	The final ranking
1	Super Stallion
2	Chinook
2	MI-26
3	H 225 M
4	AS 332

4. THE ANALYSIS OF COMBAT EXPERIENCE STARTING FROM 1970

The final criterion integrated into the analysis is that of combat experience, as in moments of crisis and tension, the individual capabilities of combatants become evident, reflecting the level of training and preparedness. As emphasized throughout the analysis, special operations forces are often deployed in areas of intense conflict, where they undertake a wide range of missions in the crucial and direct stages of confrontation. However, these units can also conduct operations in the pre-conflict and post-conflict stages of a confrontation, highlighting the necessity of superior training and adaptability in the face of various challenges and operational contexts.

For the sake of relevance and consistency, I have chosen to limit the mention of combat experience to operations and conflicts conducted by special operations forces starting from 1970. This decision stems from significant technological advancements in the military domain and the evolving nature of the battlefield, which grants this period particular significance in the development of doctrines and tactics for these units. Furthermore, this period has undergone extensive scrutiny to evaluate and validate how real-world aspects of conflict influence the training and preparedness of special operations forces.

Moreover, to ensure a deeper understanding of this subchapter, it is important to emphasize that I will not delve into details about individual confrontations, but rather highlight the operations or conflicts in which special operations forces have been involved, as well as their duration and period.

France:

- Capture of the Grand Mosque in Mecca, November 20th – December 4th, 1979, 15 days;
- Ouvea cave hostage taking, April 22nd – May 5th, 1988, 24 days;
- Gulf War, January 17th - February 28th, 1991;

- Air France Flight 8969 hijacking, December 24th – 26th, 1994, 3 days;
- Operation Azalea, September 28th – October 3rd, 1995, 6 days;
- Kosovo War, February 1998 – June 11th, 1999;
- Bosnian War, July 16th, 1994 – December 2nd, 2004;
- Iraq War, March 19th, 2003 – April 30th, 2009;
- War in Afghanistan, 2000-2010;
- 2009 raid on Somalia, 2009, 1 day;
- Trebes and Carcassonne attacks, March 23rd, 2018, 1 day;
- Battle for Talahandak, June 3rd, 2020, 1 day.[13],[14],[15],[16]

United Kingdom:

- The ethno-nationalist conflict in Northern Ireland, 1976 – 1997;
- Lufthansa Flight 181 hijacking, October 13th - 18th, 1977, 5 days;
- Capture of the Iranian Embassy in London, April 30th - May 5th, 1980, 6 days;
- Falklands War, April 2nd - June 14th, 1982;
- Gulf War, January - February 1991;
- Bosnian War, July 16th, 1994 – December 2nd, 2004;
- Kosovo War, February 1998 – June 11th, 1999;
- Sierra Leone Civil War, Operation Barras, September 10th, 2000, 1 day;
- War in Afghanistan, 2000-2010;
- Iraq War, March 19th, 2003 – April 30th, 2009.[17],[18],[19],[20]

USA:

- Salvadoran Civil War, October 15, 1979 – January 16, 1992;
- Operation Urgent Fury, Invasion of Grenada, October 25 – 29, 1983, 4 days;
- Operation Just Cause, Invasion of Panama, December 20, 1989 – January 31, 1990;
- Gulf War, January 17 – February 28, 1991;
- Operation Restore Hope, Somali Civil War, December 5, 1992 – May 4, 1993;
- Operation Uphold Democracy, Haitian Civil War, September 19, 1994 – March 31, 1995;
- Bosnian War, July 16, 1994 – December 2, 2004;
- Kosovo War, February 1998 – June 11, 1999;
- Afghanistan War, 2000-2010;
- Iraq War, March 19, 2003 – April 30, 2009.[21],[22],[23],[24]

Russia:

- Crimea Crisis (Annexation of Crimea), February 20 – 26, 2014;
- Recovery of the SU-24M plane shot down by the Turkish Army, November 24, 2015, 1 day;
- Palmyra Offensive, March 9 – 27, 2016, 18 days;
- Miracle of Akerbat, August 16, 2017;
- Operation Dawn of Idlib, April 30 – August 31, 2019.[25],[26],[27],[28]

Spain:

- Iraq War, March 19, 2003 – April 30, 2009;
- Afghanistan War, 2000-2010;
- Kosovo War, February 1998 – June 11, 1999;
- Bosnian War, July 16, 1994 – December 2, 2004;
- Gulf War, January 17 – February 28, 1991.[29],[30],[31],[32]

Before advancing to the final classification stage, it is imperative to emphasize that the list of operations and conflicts mentioned is based solely on publicly accessible information sources.

It is important to acknowledge that there is an inherent likelihood that these sources do not fully cover all actions carried out by the special operations forces of the states under analysis. This aspect must be approached with caution, as each state has an interest in keeping certain activities of its special forces secret. Therefore, disclosing other relevant information can be a challenging task, compromising the open and accessible nature of the work to the general public.

That being said, the final ranking of special operations forces in terms of combat experience is:

Table 15. The final ranking of combat experience

Place	The final ranking
1	France
2	United Kingdom
1	USA
2	Russia
3	Spain

5. MULTICRITERIA ANALYSIS OF SPECIAL OPERATIONS FORCES

This is the final step in ranking the special operations forces, encompassing the results of the previous analyses. To complete the comparative multicriteria analysis, we decided to assign scores based on the positions occupied by the respective states in the previous rankings. Thus, positions 1 and 2 will each receive 3 points, position 3 will receive 2 points, and positions 4 and 5 will each receive 1 point.

Table 16. Scores assigned to each criterion

Criteria	Ram-air parachutes[1]	Round parachutes[2]	Fixed-wing transport aircraft	Rotary-wing transport aircraft	Combat experience
France	1	2	2	1	3
United Kingdom	3	1	2	3	2
USA	3	3	1	3	3
Russia	1	3	1	1	1
Spain	3	1	3	2	2

To conduct a multicriteria analysis as fair as possible, given the information available in the study of certain criteria, I decided to assign specific weights to these criteria. The weights were chosen as follows:

Table 17. Directly estimated weights

Ram-air parachutes	Round parachutes	Fixed-wing transport aircraft	Rotary-wing transport aircraft	Combat experience
5	4	3	2	1

At this point, with the scores and criteria weights established, we can calculate the points for each state to subsequently determine the final ranking of the special operations forces within the air forces. The table with the final scores is as follow:

Table 18. The resulting scores

Alternative	Score
France	24
United Kingdom	27
USA	39
Russia	23
Spain	35

With the scores established, the final ranking can be determined, as follows:

Table19. The final ranking

Place	The final ranking
1	USA
2	Russia
3	United Kingdom
4	France
5	Spain

6. CONCLUSIONS

The proposed study undoubtedly presents certain limitations that need to be carefully addressed. Firstly, it's important to highlight the restriction to a relatively small number of items and criteria, in this case, five. This limitation may affect the accuracy and comprehensiveness of the analysis as it does not cover all relevant aspects of evaluating special operations forces within the air forces. Although the criteria selection was done carefully, including a greater number of items could provide a more comprehensive and detailed perspective on the performance of these forces.

While it can be argued that the analysis approaches reality, we must acknowledge the sensitivity of publicly available information. Information from the public domain can often be limited or biased, and some essential aspects may be subject to censorship, thereby affecting the objectivity of the analysis. Consequently, it's important to recognize that any assessment based on this information must be treated with a certain degree of subjectivity and caution to avoid erroneous or distorted conclusions.

A distinctive aspect of this study is its evolutionary nature, which allows for continuous adjustments and improvements as new equipment and technologies emerge in the arsenal of special operations forces. This adaptability is crucial for maintaining relevance and continuously updating the criteria and evaluation methodologies, ensuring that the analysis remains in step with changes in the operational and technological dynamics of these forces.

In conclusion, while the study provides an initial attempt to evaluate special operations forces within the air forces, careful consideration and a continuous process of review and improvement are necessary to ensure the accuracy, relevance, and objectivity of the analysis in the context of the ongoing changes in the military and operational domains.

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ASPECTS REGARDING THE ROLE OF RELIGIOUS MILITARY SERVICE IN THE DEVELOPMENT OF HUMILITY, AS A CHARACTERISTIC OF THE FUTURE AUTHENTIC LEADER OF THE ROMANIAN AIR FORCES

Cristian DRAGOMIR, Ionuț POPA

"Henri Coandă" Air Force Academy, Brașov, Romania (cristian.dragomir@afahc.ro, ionut.popa@afahc.ro)

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Abstract: *This paper was born out of the desire to clarify certain aspects regarding the role played by religious assistance and the actions taken by military chaplains, in resonance with those led by military instructors and teaching staff, in shaping a desirable/ideal profile of Romanian Air Force officer, through the lens of training and development of leadership skills specified by the graduate model. The approach through the prism of the element of humility was imposed by the desire to highlight the importance of training, within the "Henri Coandă" Air Force Academy, those leadership skills, with an intrapersonal connotation, which would contribute to the practice of authentic leadership by the young officers of this category of armed forces.*

Keywords: *leadership, authentic leadership, religious assistance, self-confidence, self-awareness, skills training, graduate model, Romanian Air Force.*

1. INTRODUCTION

Elite military organizations have hundreds of generals, thousands of officers, and each, in their area, is a vital, trusted leader. They became leaders through a complex process, not through mere learning or mastery of an art.

Chances are, every leader began their journey through this process as a recruit or cadet with zero haircuts, nervous and at least half-scared of what was happening, while wondering if they could survive the first week in uniform.[1]

The history of the Romanian Air Force is full of examples regarding the quality of the leaders who worked within this category of forces, and one of the aspects that made this possible was the interest shown by this organization in their training and development. What made them come to prove, through the actions they took, that they were successful leaders was the set of characteristics they each possessed and through which each of them proved their uniqueness and authenticity.

2. THEORETICAL ASPECTS OF THE AUTHENTICITY APPROACH IN THE ACADEMIC TRAINING OF THE MILITARY LEADER

The theory of authentic leadership is found in the novelty area of research in the field and has, as its focal point, the degree of originality or the extent to which the leadership practiced is real or not.

Unlike other theories that study leadership, the authentic approach refers to the authenticity of leaders and, from this point of view, can be considered more tempting to apply.

At first glance, authentic leadership would appear to be very easy to understand. In reality, it is a complex process, difficult to characterize. Among authentic leadership researchers, there is no single, accepted explanation of this theory. Instead, there are several definitions, each written from a distinct point of view and with a different emphasis.[2]

One of these points of view is the intrapersonal perspective, which focuses closely on the leader and what is happening inside him. It incorporates self-knowledge, self-regulation, and the leader's self-concept.

A second way of definition is that of an interpersonal process. This perspective highlights authentic leadership as relational, a joint creation of leaders and followers [3] resulting not only from the efforts of the former, but also from the response of the others.

As a final facet, authentic leadership can be defined from a developmental perspective, which is exemplified in the work of Avolio and his associates.[4] The development perspective, from which the theoretical approaches start, is the one that associates authentic leadership with a characteristic that can be implemented, through education, in a leader.

An approach to authentic leadership based on the unique characteristics of leaders was developed by George.[4] This leveraged her experience as an executive director in several multinational companies in that it facilitated countless opportunities for her to speak with over 125 other successful leaders. In scientific terms, she used the conversation method to discover that authentic leaders demonstrate three common characteristics: they are open to making themselves available to others, demonstrate high self-awareness, and want to apply leadership based on their own values.

Taking the practical route, George describes the essential qualities of authentic leadership and how individuals can develop these qualities if they wish to become authentic leaders.[4]

Specifically, authentic leaders demonstrate five core dimensions:[4]

(1) understand their purpose;

(2) have strong values about what is the right thing to do;

(3) establish trusting relationships with others;

(4) demonstrates self-discipline and acts according to its values;

(5) are passionate about their mission (*act from the heart*).

Taking the developmental approach, Walumbwa and his collaborators conceptualized authentic leadership as a pattern of leader behavior that develops and is based on positive psychological qualities and strong ethics.[5] They all suggested that authentic leadership consists of four distinct but related components: self-awareness, internalized moral perspective, balanced processing, and relational transparency.[6] Throughout their lives, authentic leaders learn and develop each of these four types of behavior.

Self-awareness refers to the personal, inside perspectives of the leader. It is a process by which individuals understand themselves, including their strengths and weaknesses, and the impact they have on others.

The internalized moral perspective refers to a process of self-regulation, whereby individuals use their internal moral standards and values to guide their behavior rather than allowing external pressures (eg, peer or societal pressure) to control them.

Balanced processing is also a self-regulating behavior. It refers to an individual's ability to analyze information objectively and explore other people's opinions before making a decision.

Relational transparency is about being open and honest in presenting your true self to others. It is self-regulating because individuals can control their transparency with others.

Relational transparency occurs when individuals share their underlying feelings, motives, and inclinations with others in an appropriate manner.[7]

As the theory of authentic leadership develops, further antecedents can be identified that may *influence* the process. To date, however, positive psychological capacities, moral reasoning capacities, and critical life events have been identified as factors influencing a person's ability to become an authentic leader.

The "Henri Coandă" Air Force Academy is "*...the institution of higher military education whose objective is to train licensed officers in the field of military sciences, information and public order...*", as stated in the University Charter.[8] This institution, with a tradition of training military leaders from the base of the military organization, is the one that must mold military students of all specialties so that, after the completion of the years of study, they correspond from the point of view of the requirements imposed by the beneficiary, through graduate model.

At the moment, the approach to the training of military leaders within the "Henri Coandă" Air Force Academy aims at a leader image that corresponds to the one described by means of Bloom's taxonomy of learning objectives: cognitive, affective and psychomotor.[9] The descriptive framework of this taxonomy is applied inside the model of the graduate, by describing the 5 selected competencies (citizen, educator, leader, fighter and military specialist), using in this sense 3 verbs, associated with the learning outcomes: *to be, to know* and *to do*. The element that is of interest to us, through the lens of the approach carried out in this article, is the one described by the verb *to be*.

The personality of the leader sums up traits, qualities, abilities modeled on the basis of the temperament, skills and character of each individual. This also builds the authenticity and originality of each individual leader. The military field follows the same path, because although the mission remains the same, a leader will always think and act in his own way. In this sense, we can consider that the elements of personality, those that define the character of an individual, are those that constitute guiding elements in terms of building the profile of the successful military leader.

Character is the one that describes the inner strength of a person. Character helps us to know what is right and to connect knowledge with action. In the native military doctrine the character of an individual is presented as consisting of:[10]

- Military values;
- Empathy;
- Ethos and fighting spirit;
- Discipline;
- Humility.

It can also be noted that the elements presented above are similar to those that can be discovered and are taken into account, in this sense, when applying the leader development framework, in the specialized military literature of the U.S. Army (Fig. 1).[11]

All the elements contained in the model, as a component part of the character, are particularly important, both as single elements but also as a unitary whole, where the value is highlighted by their synergistic effect.

In FM 6-22, *Developing leaders*, humility is presented as *" ... an attribute of an Army leader's character and is associated with the absence of arrogance. To be a leader, one must be confident and competent. Effective leaders temper confidence with humility. However, it is often difficult to judge one's own humility. Humility is a subjective perception based on a*

leader's behaviors and interpretations differ based on cultural or gender context. The attribute humility has one component: Seek feedback and explore personal performance."

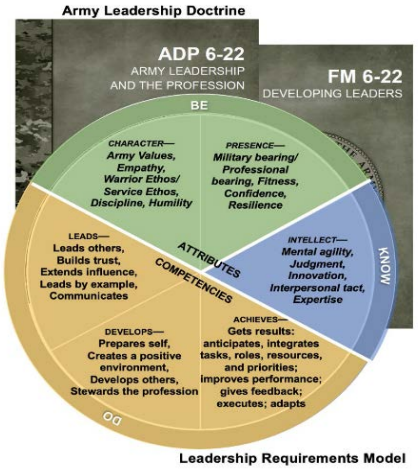

FIG. 1 Leadership requirements model

In both documents the definition of humility is done by means of its association/identification with a characteristic desired to be found in leaders at all levels of the military organization. In this sense, it is said of them that they should be able to recognize that others may have specialized expertise that is indispensable to success.

Humility exists on a continuum. [11] At the tactical level effective leaders must exhibit an appropriate degree of humility. Not to much, not too less. There must be a balance between the two extremities and this balance must be reached in the same time with the students graduation. Therefore, building up self-confidence and developing self-awareness, as one's leader ability, should occur wihin the time frame of military students being at the Academy.

It seems that each of us is gifted with the spark of leadership regardless of the field in which we operate. The real challenge is "*to understand ourselves so that we can discover where we can use our leadership abilities for the benefit of others"*.[12]

3. INVOLVEMENT OF THE RELIGIOUS ASSISTANCE IN THE PROCESS OF TRAINING THE FUTURE AUTHENTIC LEADERS OF THE ROMANIAN AIR FORCES

When we approach a profession, the first aspects we refer to are those related to the work performed, the years of study and training, the diplomas to be obtained, the code of ethics and the status acquired in society. If we refer to a nurse, a policeman, an accountant, an architect, a priest or a soldier, there is only one thing, common to all of them, that will make us truly understand what a profession is, namely that it is a calling, a vocation.[13]

Carried out on the basis of Law no. 195 of 06.11.2000 regarding the constitution and organization of the military clergy, as well as the Order of the Minister of National Defense no. M2 of 13.01.2014, for the approval of the *Regulation on religious assistance in the Romanian Army*, religious assistance is provided by military priests present in all echelons of the Romanian Army.

Although the status of the military priest - as it is found in the previously specified legislative acts - is ambiguous, oscillating between that of a military and that of a civilian, even if by the Order of the Minister of National Defense no. MS 107 of 21.09.2017, for the

approval of M.R.U. 2/1, *Norms for defining the functions of personnel in the structures of the Ministry of National Defense*, the military priest is assigned a specific type of military function of execution, the role of guide, leader of the military priest is one obviously and vocationally.

On the basis of this responsibility, intrinsic to the priestly mission, the military priest has the duty to communicate to the people he coordinates, from the perspective of religious assistance, the landmarks of authentic leadership.

Religious assistance in the Romanian Army is part of the Ministry of National Defense's area of attributions and responsibilities regarding the fulfillment of the spiritual-religious requirements of the personnel and contributes, through specific means, to the development of the cognitive component of the armed forces, by advising commanders on the psycho-moral state of subordinate staff.

Religious assistance is provided, in each unit that has a staff position, by a military chaplain. This, by the nature of the duties specified in the job description, ensures:

- assistance, accompanying military and civilian personnel to specific activities;
- counselling, guiding the commanders regarding the psycho-moral situation of the personnel under their command, offering spiritual support to the families of the personnel and guiding the personnel belonging to other confessions or cults regarding their spiritual need;
- the service, performing the liturgical acts of the cult it represents, taking care of the good organization of the cultic space and giving special importance to honoring the memory of the nation's heroes;
- catechizing, communicating the faith teaching of the Romanian Orthodox Church to military and civilian personnel;
- pastoral care, guiding the military and civilian personnel towards the fulfillment of the assigned missions, presenting milestones for the development of a healthy social and family climate, caring for the prevention of antisocial acts and collaborating with the other responsible factors in the unit to ensure the psycho-moral quality of the staff's life.

The essential condition for the military chaplain to be able to exercise his role as an advisor in the field of leadership is that he himself knows his status very well and assumes it. By this is understood both the informational assumption of the laws, provisions, statutes and regulations that define the role of the military priest, as well as the awareness of the priestly mission.

If there are still gaps in the univocal legislation of the status of the military priest, even 24 years after the resumption of the activity of religious assistance in the Romanian Army, regarding the triple dignity - teacher, servant and leader - of the priest, this is clearly established, has divine power and divine institution:

- "*And Jesus said to them again: Peace be with you! as the Father has sent Me, so I am sending you. And saying this, He breathed on them and said: Receive the Holy Spirit! Whose sins you forgive, they are forgiven, and whose sins you retain, they are retained (good).*";
- "*And Jesus approaching, he spoke to them saying: All power in heaven and on earth has been given to Me. Therefore, go and teach all nations, baptizing them in the name of the Father and of the Son and of the Holy Spirit, teaching them to observe all that I have commanded you."* (Matthew XXVIII, 18-20)

FIG. 2 Matthew XXVIII, 18-20 [14]

The awareness of this charic appropriation of the priestly dignity obliges the military priest, in addition to the rigorous evaluation of his own gestures, attitudes and actions, to the continuous appropriation of the legislative norms that establish - directly or indirectly - his military status.

Through his entire life, teaching and activity, Jesus Christ offered the world not only a soteriological gift, but also a pedagogical one, a benchmark. In this regard, Christ is the leader, the leader par excellence:

"...the shepherd of the sheep...goes before them, and the sheep follow him, for they know His voice... I am the good shepherd. The good shepherd lays down his soul for his sheep... I, the good shepherd, know mine and mine know me." (John X, 2, 4, 11, 14).

The supreme principle of the leadership quality of the Savior Jesus Christ is the sacrificial love for those he leads, respect for those "subordinates", recognition of human dignity: "... *whoever wants to be great among you will be your servant; and whoever wants to be first among you, let him be your servant* - to all, according to Mark X, 44 - *just as the Son of Man did not come to be served, but to serve and to give his soul as a ransom for many*" (Matthew XX, 26-28).

FIG. 3 Matthew XXVIII, 18-20 [15]

Within the structures of the Romanian Army, the religious assistance section conveys the christian way of life to the staff and families of this institution. a special place is reserved for the christian leadership principles mentioned earlier. these perceptions are current and useful for the psycho-social concerns of military career guidance.

The eternal truth of christian spiritual psychotherapy corresponds to the psychological objectives of self-determination of one's own instinctive starts through the awareness and self-control of emotions and the correct management of the experiences of those around, for a better efficiency of the act of command.

By focusing on introspection, as a way of taking responsibility for one's own actions, as well as by caring for the needs of others, the Christian way of life, promoted by the military priest, helps in the process of crystallization of the leader's personality.

Also, the reality of the two starts or "*minds*" - instinctual (limbic brain)[16] or rational - are presented, experienced and promoted by Orthodox mysticism right from its appearance, so that the bimillennial experience of the Church can constitute a significant contribution to the authentic edification of military leadership – "*For I do not do the good that I will, but the evil that I do not will, that I do*." (Romans, VII, 19).

CONCLUSIONS

In particular, the presence of the military priest within the academic structure of the Romanian Air Force constitutes a concrete support in the process of spiritual counseling of the commander and the management structures of the institution, both in terms of the personal experiences of each of them, as well as from the perspective pedagogical activity. The involvement of the teaching staff and students in the moments of liturgical life, completed with the catechetical side and corroborated with the pastoral effort of the military priest, are essential components of the mission of religious assistance.

Through his attitude and interventions, the military chaplain can alleviate the privations of student military life, generated by the distance from the family, and can capitalize on the positive aspects, such as the joy of discovering people and the creation of new social groups, strengthened by common concerns and skills. At the same time, the involvement of the military priest in activities supporting the educational process can only be welcomed, through the prism of the beneficial effects that can occur at the level of the process of shaping the personalities of future air force officers.

The efforts of the military chaplain, in support of achieving the desired goal imposed by the graduate model and in the sense of what is presented in this article, must be focused on building a strong self-awareness and achieving a high capacity to exercise an internalized moral perspective, through the promotion and cultivation of a personality cult fueled by humility.

Developing such skills and putting them into practice, from the lowest level of applicability in leadership, represents the foundation for a future certainty associated with the impossibility of non-productive/toxic effects in the exercise of the act of leadership.

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