REPÜLÉSTUDOMÁNYI KÖZLEMÉNYEK
35. évfolyam (2024) 2. szám 109–115. • DOI: 10.32560/rk.2024.2.8

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The Emergence of Classical Military Virtues in Air Force Teams and Their Modern Assessment Possibilities

Aviation, which plays an indispensable role in our daily lives across the transportation, economic, military, and healthcare sectors, is an exceptionally complex system where the human factor holds a dominant position. The decisions, physical, and mental condition of aviation professionals – such as pilots, flight attendants, and other key personnel – have a direct impact on flight safety. Analysing the works of classical military theorists, we see that while their focus was primarily on strategy and the theory of warfare, numerous parallels can be drawn to the domains of human factors and aviation safety. This provides deeper insights into the mechanisms of decision-making and stress management. Although the relentless advancement of automation and technology has significantly increased the efficiency and safety of aviation, the human factor remains a critical element. The development of modern biomedical and information technology tools has opened new possibilities for real-time monitoring of physiological states during flights, which is essential for reducing aviation safety risks.

Keywords: *military virtues, biometric data analysis, physiological effects, human factors, flight safety, aviation environment, automation, military science*

1. Introduction

Work conducted on aircraft predominantly takes place in environments with reduced or low oxygen levels, posing significant strain on the human body as a whole. Factors such as gravitational forces, occasional hypoxia due to environmental characteristics, reduced atmospheric pressure, extreme durations of workload, and external pressure exertion all contribute to both physical and mental challenges for aviation professionals. These conditions not only affect reaction times, decision-making capabilities, and divided attention of those involved in flight operations, but also pose a direct threat to overall flight safety. The purpose of biomedical monitoring is to enable the timely identification of such issues and provide opportunities for appropriate intervention. Modern portable diagnostic devices and their associated information and communication systems – such as pulse oximeters, blood oxygen monitors, and even EEG equipment – are becoming increasingly widespread. These tools can gather real-time information about physiological conditions, allowing the rapid identification of deviations that signal potential risks. The implementation and use of these systems are not

solely intended to monitor the health of flight personnel but also have a clear and decisive objective: to enhance overall flight safety [1]. To gain the most comprehensive and easily understandable perspective on the studied field, it is essential to look back at the foundations of safety and human strategies rooted in the past. Throughout the history of military science, numerous events and thinkers have laid an excellent scientific foundation for identifying the origins of the key concepts discussed in this study. This article aims to provide an overview of aviation safety and technological issues examined through the lens of classical military values, placing them into a contemporary context. It explores the opportunities provided by technological advancements, current challenges, and future directions that could further enhance flight safety. Understanding the human factor more thoroughly and monitoring it in real-time are key to making aviation even safer in the future.

2. The military roots of human factors and safety

Among the scholars of military science, the works of some thinkers are only indirectly connected to modern aviation safety or human factors. However, the principles and strategies they established have had a profound impact on examining the correlation between human factors and technology. This chapter highlights a select few classics whose ideas can be indirectly linked to the fields of aviation safety and human factors.

Carl von Clausewitz (1780–1831) in his seminal work *On War* emphasises the pivotal role of the human factor. While analysing the unpredictable and chaotic nature of war, he concludes that human will, intuition, and experience significantly shape decision-making and its outcomes. He particularly highlights the decision-making capabilities of commanders and the influence of emotional and psychological factors on the battlefield. This perspective directly applies to modern aviation safety, where aviation professionals must make swift and effective decisions in unconventional situations, such as unexpected technical or organisational challenges, adverse weather conditions, or critical emergencies. Clausewitz introduces the concept of "friction", a term he uses to describe unforeseen events in military operations. In the aviation environment, this analogy can be applied to the detection and management of human-machine interaction failures, as well as the effects of stress and fatigue. His observation that, under the "fog of war", military leaders must rely on intuitive judgments is closely aligned with the situational awareness (SA) required of pilots, which is fundamental to ensuring aviation safety [2].

Antoine-Henri Jomini (1779–1869) is renowned for his systematic and logical approach to warfare. His perspective is particularly relevant to modern aviation safety, as the design and operational mechanisms of safety structures rely heavily on thorough analysis, foundational principles, and systematic thinking. One of the core elements of Jomini's strategy is the concept of "key points" and the concentration of available resources on these critical areas. In aviation safety, this approach is evident in risk management procedures that focus on critical aspects of human factors, such as stress management and fatigue monitoring. Additionally, Jomini emphasised the importance of discipline and well-defined standards, which closely align with modern aviation rules and protocols designed to minimise the potential for human error [3].

Giulio Douhet (1869–1930) focused on the theory of aerial warfare, emphasising the strategic importance of air forces and the reliability of tools used in aerial combat. He was

one of the first strategic thinkers to thoroughly analyse the role and consequences of air warfare. His work is particularly relevant to aviation safety, as he placed significant emphasis on the relationship between aircrew and aircraft. According to Douhet's theory, the training, physical preparedness, and psychological resilience of aircrew are critical factors for success in aerial operations. This directly parallels modern approaches to aviation safety, particularly in relation to human factors. His concept remains highly relevant today, especially concerning the real-time monitoring of the condition of aircrew and aviation professionals. Douhet's emphasis on the reliability of technology and the establishment of conditions for safe operation are fundamental principles in contemporary aviation. He astutely highlighted that the rapid advancement of technology does not diminish the importance of human factors; rather, it increases the significance of effective collaboration between humans and machines [4].

Billy Mitchell (1879–1936), a pioneer in the development of the U.S. Air Force, placed significant emphasis on the combined importance of human and technological factors. Mitchell stressed that the endurance, mental preparedness, and training of flight personnel fundamentally determine the success and safety of aviation operations. He highlighted a principle that remains crucial today: the integration of technology and human factors is essential. According to Mitchell, one of the indispensable elements in preventing aviation incidents and accidents is fostering harmony between personnel and equipment. His ideas are directly related to aviation safety systems, which aim to enhance the efficiency of human-machine cooperation. Mitchell's work anticipated the importance of simultaneously advancing aviation science and human factors, a concept that continues to play a key role in aviation safety today. His vision provided the foundation for modern air traffic management structures and training programmes, which ensure efficient operations by incorporating human factors into their design and implementation [5].

Sun Tzu (ca. 544–496 BCE), in his renowned work *The Art of War,* outlines universally applicable strategic and tactical principles, emphasising preparedness and adaptive flexibility. These principles are not only relevant to warfare but also highly applicable to aviation safety. According to Sun Tzu, the most effective strategy is prevention – assessing situations in advance, emphasising preparation, and adapting to circumstances. This principle aligns seamlessly with aviation safety, where identifying risks and minimising hazards beforehand are critical. The monitoring of human factors, such as tracking the mental and physical condition of pilots, reflects this preventive approach. Additionally, Sun Tzu highlights the importance of leadership and teamwork, which are indispensable in the collaborative efforts of aviation professionals. In modern aviation, effective communication and cooperation among pilots, flight attendants, engineers, and ground controllers are among the most critical elements for ensuring safety. This principle of coordinated teamwork mirrors Sun Tzu's vision of the harmonious interplay of roles in achieving success [6].

3. Military virtues in aviation

It is essential to examine military virtues – such as decision-making and action-oriented capabilities representing the human dimension – and their significance in the field of aviation, particularly within the air force. The philosophical and practical approaches to these qualities are undoubtedly applicable to modern air force operations, where rapid decision-making,

discipline, and reliability are fundamental requirements. Military virtues are a collection of values and norms historically and culturally defined by the military profession. These are not merely moral categories but also precise guidelines for action that are applied in the conventional activities of defence personnel. In air force units, these virtues manifest in the cooperation between pilots, controllers, and ground personnel, in handling stressful situations, and in fostering harmony between technology and human elements. Discipline, perseverance, and quick situational awareness are especially critical for those working in the air force [7]. This study explores how these capabilities are manifested and whether they can be effectively monitored to enhance aviation safety. The goal is to determine how leveraging these virtues and their practical application can elevate safety standards in aviation operations.

Discipline and precision serve as the cornerstone of air force operations, upheld through strict adherence to established rules and protocols. Discipline ensures that pilots and ground personnel execute their tasks with accuracy, minimising the risk of human error. Discipline is particularly crucial in unforeseen circumstances, such as emergencies, where the swift and composed application of procedures – meticulously practiced over years – is essential to achieve a safe landing.

Aerial operations often involve extreme physical and mental strain, demanding courage and self-control. Aircrew members must be capable of making sound decisions under significant pressure, even when these decisions carry substantial risks depending on the situation. Courage is not synonymous with recklessness; it involves acting correctly and consciously, even with full awareness of the dangers, by making a series of rational decisions based on careful assessment. This approach forms the foundation of effective risk management. Self-control, in a military context, signifies the ability to maintain mental and emotional stability [8]. In air force teams, courage and self-control can be assessed and monitored through stress evaluation tests, simulations, virtual environments, and real-time biomonitoring. Supported by modern technologies, such as pulse monitoring and EEG measurements, the response of personnel to unexpected situations can be tracked effectively.

Military service tests both physical and mental endurance, which is directly linked to the virtue of perseverance. Perseverance must manifest not only in physical stamina but also in mental resilience. In aviation, this is a fundamental trait, as the likelihood of successfully completing tasks diminishes without it. Related to perseverance are adaptability and flexibility. In the rapidly changing aviation environment – such as managing weather conditions or technical challenges – constant adaptability is required to make timely and effective decisions. This ability extends beyond technical expertise, encompassing psychological flexibility, which enables effective handling of stressful situations.

For air force personnel, these qualities can be monitored through long-duration tasks assessing endurance, regular medical evaluations, simulations, and personality tests. Wearable biotechnological devices, such as those measuring heart rate, oxygen saturation, and cortisol levels, facilitate tracking endurance and stress tolerance from a medical perspective.

Leadership and teamwork skills are not only fundamental for air force personnel but also essential across the entire military. In most cases, soldiers work in teams where effective communication and the ability to follow leadership are critical. Ideal leadership ensures that every team member understands their tasks and roles, enabling them to collaborate effectively toward a common goal. Discipline forms the cornerstone of military life, ensuring hierarchical order and adherence to rules. In aviation – whether civilian or military – discipline is equally

a foundational pillar. Obedience, however, does not imply passive subordination but rather informed, active participation in achieving shared objectives [9]. In the air force, the levels of discipline and obedience can be assessed through flight exercises, teamwork evaluations, and protocol adherence checks. Accurate execution of procedures and compliance with instructions are also pivotal in preventing accidents.

Loyalty and commitment manifest in dedication to the community and profession, as well as in perseverance toward shared ideals and objectives. In the air force, loyalty can be measured by the trust and cooperation among team members. The level of teamwork and dedication can be assessed through communication tests between flight crews and ground controllers, as well as post-mission evaluations that gauge the sense of community and commitment. Military traits are evident not only on an individual level but also within organisational culture. However, the rapid advancement of technology introduces new and sometimes unfamiliar challenges to the role of human factors. In human-machine interactions, achieving a balance between human decision-making and technological reliability is crucial. Aircrew members must excel not only in operating aircraft but also in overriding the decisions of autonomous systems when necessary, particularly in critical situations.

4. Examination of military values in the air force

The examination of military values in the air forces is crucial for maintaining military ethics and professional standards, which is not merely an administrative task but rather a complex and dynamic process aimed at preserving and developing the ethical and moral norms of soldiers. These values apply not only to individual soldiers but also to leaders as a shared guideline to follow. Below, I will discuss the significance of military values, the methods of examination, as well as current trends and challenges [10].

Psychological tests and simulations play an extremely important preventive role in the selection and training of military personnel, as they assess decision-making speed, stress tolerance, and the ability to maintain self-control. Simulation exercises, such as emergency drills that model realistic situations, help to map out personnel reactions and the quality of their decisions in critical situations.

The performance of soldiers and pilots is regularly evaluated, considering and incorporating the implementation of the discussed values. This assessment reflects, to some extent, bravery in real situations and discipline in the execution of orders and protocols. The detailed post-training evaluations following flight exercises, simulator training, and tasks, which examine the accuracy and speed of decision-making and actions, are also milestones in evaluating an individual's performance. During debriefing, personnel members receive feedback on their performance and the areas in which they need improvement.

When evaluating the overall performance of soldiers, not only are technical skills assessed, but also the realisation of fundamental virtues arising from organisational characteristics. As a part of training and development programmes, curricula follow a structure aimed at developing military values, such as leadership skills and stress management. Mental health practices and stress management techniques also play an important role in ensuring effective task execution. Additionally, the aim is to raise awareness of the importance of virtues in

everyday service. Examples of such practices include the use of simulators and situational exercises, where realistic scenarios are modeled, requiring pilots to make decisions.

Real-time tracking systems and advanced biotechnological tools, such as wearable sensors that monitor the physiological states of those involved in aviation (heart rate, blood pressure, stress hormone levels), provide real-time feedback on how the individual responds to stress. EEG-based systems allow monitoring of pilots' mental states (e.g. attention, concentration), which directly influences the development of the decision-making chain.

5. Summary

Although the classics of military science primarily studied the aspects of war and strategy, they established principles that are still relevant today in the study of aviation safety and the human factor. The research and ideas of these scholars highlight the importance of human decision-making, stress management, organisation, and prevention, all of which play a key role in handling critical situations – this includes the entire scope of civil and commercial aviation. While they did not directly address aviation safety, their principles have influenced the development of modern flight structures, particularly in understanding the relationship between human factors and technology. Military values such as discipline, courage, flexibility, and leadership skills are not only important from an individual performance perspective, but they also play a pivotal role in the safe and efficient operation of air forces. These virtues can be developed and maintained through training, real-time monitoring, and constant performance evaluation of military personnel. Modern technologies, such as biometric monitoring systems, offer excellent opportunities for real-time tracking and optimisation of human factors, significantly contributing to the enhancement of aviation safety. Principles like courage, discipline, perseverance, and loyalty are not mere abstract concepts; they have practical significance in the daily operations of the air force. These virtues help maintain ethical standards and professional conduct, while modern technologies allow for the objective monitoring of these characteristics. In order to continuously improve aviation safety, it is essential to focus on the targeted development of military virtues and the harmonious integration of technology with human factors. Training programmes and performance evaluation systems for aviation personnel ensure that, alongside technical preparedness, ethical considerations are also prioritised. When responding to new challenges, it is important to adapt ethical norms and integrate current technologies, such as autonomous systems, into everyday operations.

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A klasszikus katonai erények megjelenése a légierős csapatoknál és azok korszerű vizsgálati lehetőségei

A repülés, amely mindennapjainkban megkerülhetetlen szerepet vállal a közlekedési, gazdasági, hadi és egészségügyi területeken egy rendkívül összetett rendszer, amelyben az emberi tényező domináns szerepet játszik. A repülésben részt vevő szakemberek, mint például a pilóta, a légiutaskísérő és egyéb területek képviselői döntései, fizikai és mentális kondíciója direkt hatással van a repülésbiztonságra. A hadtudomány klasszikus gondolkodóit is elemezve látjuk, hogy többnyire a stratégia és háborúelmélet aspektusait vizsgálták, de számos ponton párhuzam vonható az emberi tényező és repülésbiztonság területével, amely által részletesebb betekintést nyerünk a döntéshozatal és stresszkezelés mechanizmusába. Jóllehet az automatizáció és a technológia rendületlen fejlődése nagymértékben növelte a repülés hatékonyságát és biztonságát, az emberi tényező továbbra is kiemelkedő helyet foglal el a kritikus elemek palettáján. A korszerű orvosbiológiai és információtechnológiai eszközök fejlődése azonban új kapukat nyitott meg a repülések során vizsgált fiziológiai állapot valós idejű monitorozása területén, amely kulcsfontosságú a repülésbiztonsági kockázatok csökkentésében.

Kulcsszavak: *katonai erények, biometrikus adatelemzés, fiziológiai hatások, emberi tényező, repülésbiztonság, repülési környezet, automatizáció, hadtudomány*

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