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THE TECHNOLOGICAL REVOLUTION AND THE IMPLICATIONS ON MILITARY STRATEGY CASE STUDY – MILITARY HELICOPTERS

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Nowadays, more than ever, the link between military strategies and the technological revolution has become a social need. If the war has its origins at the beginning of human civilisation, analysing the succession of historical events in time, it can be observed that, as far as the concept of military strategy is concerned, there have been constant and proportional evolutions which have been most of the times triggered by the appearance and development of new weapon systems. Under these circumstances, military doctrines adapt to the new realities, and even if the general areas that define military strategy, operational art and tactics remain mainly unchanged in principle, the impact of technology obviously influences and highlights the development of military art by changing the content of certain concepts. At the same time, developing and adapting the concept of military strategy can lead to a technological revolution with applicability in the military field.

Keywords: military strategy, technological revolution, family of systems, multi-domain, multi-combustion.

1. Introduction – conceptual delimitations

The historical evolution of the concept of military strategy has gone through a complex and long-lasting development path ever since the earliest attempts to theorise the military experience. It has been a difficult and winding process, with moments or periods of marked by momentum, stagnation or even regress. The constant of this process, however, is represented by the permanent tendency of evolution and improvement both horizontally and vertically, throughout history, according to the economic, social, political, military etc. particularities and characteristics of every era.

In ancient times, strategy meant the “*art of command*”, which is to lead all the forces and means necessary to achieve victory on the battlefield. This interpretation is recognisable nowadays when we talk about tactics. The plans of army leaders and the way they were implemented on the battlefield did not bear an independent name until the end of the 18th century. In 1766, French infantry Lieutenant Colonel Paul Gideon Joly de Maizeroy published a work called *Cours de tactique, theoretique, pratique et historique*¹, which, as the title reveals, introduced the concept of tactics in war theory. Ten years later, the same Joly de Mazeroy published *Theorie de la guerre*, a work that identified a second level of the art of war, which he called *strategy*: “*Making war is a matter of reflection, combination of ideas, foresight, reasoning in depth and use of available means... In order to formulate plans, strategy studies the relationship between time, positions, means and different interests, and takes every factor into account... which*

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¹ Paul Gideon Joly de Maizeroy, *Cours de tactique, theoretique, pratique et historique*, J. B. Hiacinthe Leclerc, Paris, 1766, https://archive.org/details/bub_gb_bA5Z_w2VEpgC/page/n5, retrieved on 16.02.2019.



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is the province of dialectics, that is to say, of reasoning, which is the highest faculty of the mind”².

Napoleonic wars confirmed the difference between tactics and strategy and even if Napoleon did not use the word strategy, the most important military theorists of the 19th century, Clausewitz and Jomini, did not hesitate to do so.

Jomini divided the art of war in six distinct parts (Diplomacy, Strategy, Grand Tactics, Logistics, Engineering and Tactics), strategy being defined as *“the art of properly directing masses upon the theatre of war, and the art of making war upon the map, either for defence or invasion”³.*

Jomini’s classification dominated the ideas about the art of war until the First World War. His ideas about planning, mapping and communication lines were the attribute of major states, institutionalised structures from the military point of view during the 19th century. It was a revolution in terms of military thinking, considering that, until 1900, all that meant commanding troops on the battlefield was understood as the exclusive decision of the commander of the army in a war.

Strategy thus became the link between politics and tactics, and the three concepts formed a whole that had to be maintained in harmony. Therefore, a struggle of ideas emerged on the subject of the extent to which politics still had to intervene from the moment the war was declared. Even though, in Clausewitz’s view, war was nothing more than a continuation of politics by other means, it was necessary to establish the role of politics in the process of leading the war.

Clausewitz’s thesis according to which the military point of view should be subordinated to the political one, found opposition in the thesis of Marshal Helmuth Graf von Moltke, a former Chief of the German General Staff, according to which *“once war was declared, the statesman should fall silent until the general delivered the victory”⁴,*

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² Paul Gideon Joly de Maizeroy, *Theorie de la guerre*, quoted by Julian Lindley French and Yves Boyer in *The Oxford Handbook of War*, Oxford University Press, 2012 p. 31, https://books.google.ro/books?id=CWEODZexAJ4C&printsec=frontcover&dq=the+oxford+handbook+of+war&hl=ro&sa=X&ved=0ahUKewiTo7WdiL_gAhUS-yoKHV9eBjMQ6AEIKzAA#v=onepage&q=the%20oxford%20handbook%20of%20war&f=false, retrieved on 16.02.2019

³ Baron Antoine-Henri Jomini, *The Art of War* – restored edition, Published by Legacy Books Press, 2009, Ontario, Canada, p. 41.

⁴ Gerhard Ritter, *The Sword and the Sceptre: The Problem of Militarism in Germany*, 4 volumes Allen Lane, London, 1969-73, vol. I, pp. 187-260.

and this idea was taken over in one form or another by most strategists of that time.

On the other hand, during the First World War also, the armed forces of the belligerent countries reached unprecedented proportions, and that is why it emerged the possibility of creating powerful troop groups, able to carry out on their own great combat actions, which no longer belonged to the tactical level, nor did they reach the strategic level. As a result, a new level of organisation and command of combat actions between the strategic level and the tactical one was necessary – the operational level⁵.

It should be noted that, until the end of the First World War, the definitions of military strategy referred exclusively to ground military actions and neglected actions at sea. Under these circumstances, one of the most influential theorists of that time, Basil Liddell Hart, argued that the war was not won due to the ground actions on the western front, but the decisive factor was the naval power, making a distinction between the land forces strategy and the naval strategy. Under these circumstances, Julian Corbett, the first relevant British strategist, introduced the grand strategy and the minor strategy concepts, the latter summing up the strategy of land forces and naval forces: *“Plans of operations, the selection of objectives and the direction of the forces assigned to the operation were now not strategy but minor strategy. Major strategy in its broadest sense has also to deal with the whole resources of the nation for war. It is a branch of statesmanship. It regards the Army and Navy as parts of the one force, to be handled together; they are instruments of war. But it also has to keep in view constantly the politico-diplomatic position of the country and its commercial and financial position”*⁶.

The concept of the *Grand strategy* introduced by Corbett prefigured what the British would call *Grand Strategy* and the Americans *National Strategy*. Contemporaneous with Corbett, Alfred Thayer Mahan contributed to the development of the grand strategy concept, connecting it with economic policy: *“Maritime trade was vital to national prosperity, and naval superiority was essential*



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⁵ Corneliu Soare, Romul Duma, Ioan Muntoi, *Teorie și doctrină militară*, Editura Militară, București, 1971, p. 433.

⁶ Julian Corbett, *Some Principles of Maritime Strategy*, ed. Eric Grove, Brassey's Annapolis, MD, 1988, 1st edition London, 1911, p. 308.



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Liddell Hart introduced the term pure strategy, used in connection with grand strategy: “Pure strategy was still the art of the general. But the role of grand strategy was to coordinate and direct all the resources of the nation towards the attainment of the political object of the war – the goal defined by national policy”.

to the protection of the nation’s interests. That naval superiority in itself depended on the seafaring traditions of the population, the nation’s culture and the state’s political structure”⁷.

This connection between strategy and economy, with reference to war preparation policy during peacetime, was developed by J.F.C. Fuller. Moreover, he anticipated the third component of the military strategy – air power, and supported the principle of cooperation of the three weapons for maximum efficiency: *“In the past, in spite of the universal nature of the principles of war, there has been a land strategy, a sea strategy, and the future may possibly see added these two an air strategy. This process of separating strategy into three compartments I believe to be fundamentally uneconomical and a direct violation of the principle of economy of forces as applied to a united army, navy and air force, and hence a weakening of the principle of the objective. This separation is faulty, consequently I will now consider the strategy of all three forces as combined... During war, nothing is so uneconomical as improvisation; consequently, our peace strategy must formulate war strategy... - moral, physical and materials, when war breaks out. The first duty of grand strategist is, therefore, to appreciate the commercial and financial position of his country... secondly, he must understand the moral characteristics of his countrymen, their history, peculiarities, social customs and system of government, for all these quantities and qualities form the pillars of the military arch which it is his duty to construct”⁸.*

Fuller’s theory was assumed and developed by Liddell Hart, who argued that Great Britain’s strategy should not be limited to the specific features of a land war, but it was essential to relate to the British context and thus to the specific politics, geography and economy of the Kingdom. In this regard, Liddell Hart introduced the term *pure strategy*, used in connection with *grand strategy*: *“Pure strategy was still the art of the general. But the role of grand strategy was to coordinate and direct all the resources of the nation towards the attainment of the political object of the war – the goal defined by national policy”⁹.*

⁷ Jon Tetsuro Sumida, *Inventing Grand Strategy and Teaching Command: The Classic Works of Alfred Thayer Mahan Reconsidered*, Woodrow Wilson Center Press, Washington DC, 1997, p. 27.

⁸ J.F.C. Fuller, *The Reformation of War*, Hutchinson, London, 1923, pp. 217-218.

⁹ Basil Liddell Hart, *When Britain Goes to War*, Faber, London, 1928, p. 83.

From the above-mentioned description, it can be concluded that the theory of strategy – grand strategy – studies the use of all military forces and means of the state in the war. This means that the military strategy – pure strategy, has the task of designing the general principles related to the use of various categories of armed forces and coordinating their efforts in order to achieve the political and military objective.

Thus, there is a close connection between strategy, on the one hand, and operational and tactical art, on the other hand. The military strategy has a leading role, because it defines the general purpose of the actions, forces, means and methods of performing the tasks that lie ahead of operational art and tactics. The mutual conditioning of all parts of the military art theory and the leading role of the strategy is explained by the fact that in a war each partial success is subordinated to the general purpose. That is why the principles of tactics must correspond to the goals of operational art, which in turn derive from the goals of the strategy.

Looking at things the opposite way, we find out that the military strategy is part of the national defence strategy, to a larger or smaller extent, according to the national interest of each state and the historical moment taken into account. Yet, regardless of the share it holds at any given moment, the military strategy is built taking into consideration a possible military conflict, and takes into account the following aspects: conception, organisation, leadership and execution.

On the other hand, the modern strategy cannot be developed without taking into account the economic, political and technical-scientific factors. In its forecasts, the strategy must be based on contemporary achievements in the fields of science (physics, chemistry, communications, cyberspace etc.), as issues related to the preparation and use of the armed forces in the war cannot be solved without taking these achievements into consideration. Therefore, as Collin S. Gray pointed out, “strategy is neither policy nor armed combat; rather it is the bridge between them”¹⁰.

Considering all these aspects and interpretations mentioned above, we can assume that the strategy is a concept developed on levels, and an up to date hierarchy might be the following: politics – sets

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¹⁰ Colin S. Gray, *Why Strategy Is Difficult*, in *Strategy and History, Essays on the Theory and Practice*, New York, 2006, p. 77.



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The military strategy is a concept that adapts itself continuously, taking into account the evolutions of all the factors regarding the whole society.

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the objectives pursued in a possible war; grand strategy – coordinates the use of resources of a state or of states of a coalition in order to achieve political goals; military strategy – coordinates military forces to achieve policy objectives; operational strategy – provides the conceptual and/or geographical link between tactical actions to achieve military strategy objectives; tactics – represented by actual actions on the battlefield, face to face with the declared enemy¹¹.

The technical-scientific revolution that began with the armaments mechanisation and continued until nowadays with the latest innovations in communications or in the field of airspace, having direct applicability in the military environment, created the premises to consider military science as a science itself. Therefore, the military strategy is a concept that adapts itself continuously, taking into account the evolutions of all the factors regarding the whole society, a definition of present-day being considered the following: military strategy is “a field of military art that studies the ways of its creation and its use in an efficient and synchronised manner with the other state power vectors, to achieve the desired final state at strategic level and to fulfil the political purpose of the war”¹².

2. The strategy – technological revolution connection

The perpetuation of the revolution that has occurred in science and technology since the end of the 19th century has influenced the entire field of military science so far, both theoretically and practically. Armaments, armed forces organization, action processes, or human-to-weapon systems relationship have been permanently adapted, being marked by new and important particularities according to technological evolution. Now it can be appreciated that the most important implications of the current technical-military revolution are manifested in the sphere of human-technical relations, and their understanding represents a condition for solving many of the problems caused by the modern war and the development of military science.

¹¹ David Jordan, James D. Kiras, David J. Lonsdale, Ian Speller, Christopher Tuck, C. Dale Walton, *Understanding Modern Warfare*, Cambridge University Press, United Kingdom, second edition, 2016, p. 42.

¹² Constantin Popescu, *Elemente de teorie a strategiei militare*, Editura Universității Naționale de Apărare “Carol I”, București, 2015, p. 28.

The theory according to which the military strategy represents a level of military art that has within its scope *“the science and art of using the armed forces or the threat with their employment for the fulfilment of political objectives”*¹³ does not seem as effective today as it was one or two decades ago. There is no question that the Clausewitzian formula according to which war is the ultimate way to be used to achieve a strategic goal is no longer up to date, but it must be adapted to new realities. Thus, the military strategy must play a well-defined role in the application of other field strategies (information, economic, diplomatic, etc.) in order to avoid a military conflict or, at least, to ensure the principle of capturing the enemy and military neutralising it in the shorter time possible and with minimal human or materials losses. This continued transformation due to the evolution of technology leads to a new evidence: *“politics acquires more and more strategic/military valences, and the strategy becomes more and more political”*¹⁴.

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Strategic military actions that seek to achieve political goals differ from epoch to epoch, depending on the nature of the means at the disposal of the strategy. The main means of the military strategy are represented by the human force, namely the fighters, and the technical equipment, respectively the armament. That is why the military strategy must take into consideration the human being, who continues to represent the main element in setting the strategy, as well as the armament and technique development.

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The development of armaments and weapon systems has major influences on all aspects of the strategy, starting with its definition, strategic mobilisation organising and strategic entities creation, establishment of the types and forms of strategic action, future weapons systems and military equipment manufacture etc.

The destructive force of combat weapons systems tends to increase without limit. Under these circumstances, the following question arises: should the strategy be automatically shaped by the latest technical achievements or not? An increasing number of military authors believe that setting the destructive capabilities of the current and future weapons systems or armaments as a starting point in defining

¹³ *Eseu despre strategia și tactica militară*, Editura A.Î.S.M., București, 1995, p. 15.

¹⁴ Colonel Constantin Onișor, *Corelația politică-strategie*, in *Curs de strategie*, Colegiul Național de Apărare, 1996.



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In the 14th century, when gunpowder passed from the Arabs to the Western European peoples, and as a result, the firearms appeared, a period of radical qualitative changes began regarding the procedures of warfare.

military strategy, the strategy is likely to get out of political control, transforming into a strategy of destruction, unrelated to political goals. Such a strategy, as the nuclear strategy, for instance, that can lead to the destruction of mankind, would lie outside the very essence of the war, considered to be the continuation of politics with violent means: *“assured destruction, let alone mutual assured destruction, is a denial of strategy and, in action, could serve no conceivable political purpose”*¹⁵. As a result, it is believed that politics should guide not only the strategy of war itself, but also the strategy of producing weapon systems and military equipment.

The development of modern weapon systems produces important changes in the forms and procedures of organising and conducting military operations. For instance, the missiles with technical-operational characteristics allow a simultaneous action on the entire operational depth of the enemy, separating their troops into different parts, which makes it easier to destroy them¹⁶.

The specificity of the technical-military revolution consists in the fact that it is determined by the technological progresses, which have as result the emergence of a completely new weapon or armament, totally different from what was known until the moment of emergence. Therefore, the technical-military revolution means a radical change in the combat weapons, the emergence of a new type of armament, much more qualitative than all existing combat means, which leads at the same time to the emergence of new forms and methods of combat, to new forms of armed forces organization, to a new military art theory.

In history, there are several technical revolutions that determined radical changes in the military art.

In the 14th century, when gunpowder passed from the Arabs to the Western European peoples, and as a result, the firearms appeared, a period of radical qualitative changes began regarding the procedures of warfare. The emergence of firearms determined a revolution in the military art which took place quite slowly during that period, due to the low level of the existing technique. It lasted for hundreds of years, ending only at the beginning of the 18th century.

¹⁵ Colin S. Gray, *Războiul, pacea și relațiile internaționale – o introducere în istoria strategică*, Editura Polirom, București, 2010, p. 250.

¹⁶ Corneliu Soare, Romul Duma, Ioan Muntoi, *op. cit.*, p. 435.

The end of the 19th century and the beginning of the 20th century marked a new revolution in weapon systems, determined by the use of new scientific discoveries and technological progress for military purposes. The main elements of this revolution were: the emergence of automatic fire systems and fast-firing anti-aircraft guns (cannons), the widespread use of the engines for military purposes, the emergence of tanks, airplanes, and combat gas, all of which led to what is now known as the Modern Warfare: *“Between 1917 and 1918, a Revolution in Military Affairs took place which, it is contended, was more than merely that: rather it amounted to a Military Revolution, which was the most significant in the history of warfare to date, and remains so. It amounted to the birth of what will be termed the Modern Style of Warfare”*¹⁷.

The third stage in the field of technical revolution is the emergence and development of nuclear weapons. Therefore, a strategy emerged based on the nuclear weapon¹⁸, that operates with different concepts and principles from those of the classic strategy. In this regard, it is mentioned that the character and procedures of the warfare had changed, because the traditional warfare, especially the land war in the course of which the main objectives of the armed combat were achieved by confronting the belligerent forces within a military operations theatre, was replaced by the nuclear one. In reality, the so-called nuclear arms race¹⁹ did not exclude the strategy based on conventional means of combat, but it has completed the strategic patrimony with an important set of nuclear-based theories. Evidence in this regard is that no nuclear war took place, but a series of classical conflicts were carried out in full nuclear arms race.

Until the Second World War, the means of combat had a tactical character because of their individual effects. During the Second World War, however, strategic bombers, V-type missiles and, finally, the atomic bomb emerged, all of which surpassed the sphere of tactical action. *“This escape”* from the tactical sphere of the armament resulted in an increasing development in the post-war period and led to the emergence of a new category of armament – strategic armament.

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¹⁷ Jonathan Bailey, *The First World War and the Birth of Modern Warfare, The Dynamics of Military Revolution 1300-2050*, Ed. M. Knox and W. Murray, Cambridge UP, 2001.

¹⁸ mwi.usma.edu/science-technology-future-warfare/, retrieved on 10.01.2019.

¹⁹ Colin S. Gray, *op. cit.*, Editura Polirom, București, 2010, p. 253.



Currently, the strategic arsenal consists of nuclear warheads of various types and of carrier platforms covering all physical dimensions of the armed combat (terrestrial, naval and air): intercontinental and mid-range missiles, strategic bomber planes, missile submarines, aircraft carriers, surface ships armed with missiles, 5th-generation aircraft, unmanned aerial vehicle, military satellites, etc.

The fourth stage of the technological revolution is considered to be the introduction of digital technology in the weapon systems, doubled by the revolution in military communications. The extremely rapid evolution of technology in those two sectors has major influences on how the military strategy needs to be adapted to new realities. An example in this regard would be the emergence of a new force in the organisational structure of the main military powers, namely the strategic airspace force²⁰.

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The dimensions and pace of these technological changes were accessible to states such as the US, Russia, China, which established the goal of dominating the field of high technology, including their military applicability, and were able to allocate important resources to this purpose. They also highlighted the possibilities generated in the military field by the technical-scientific revolution, which did not mean that these possibilities automatically became realities in all countries where the economic possibilities and political choices could be identical to those of the mentioned states. As a partial conclusion, it can be stated that the military strategy, as well as the business strategy (here the technological revolution) had to evolve in response to the constantly changing operational environment²¹.

3. The impact of the advent of the helicopter on military strategy

Prior to the invention of the aircraft, a belligerent nation sent its army against the enemy army in order to penetrate the country's vulnerable interior. Sometimes, battles lasted no more than a day, a battle by which a winning side was decided, for instance the way

²⁰ <https://www.space.com/president-trump-space-force-directive.html>, retrieved on 20.02.2019.

²¹ hbr.org/2002/04/maneuver-warfare-can-modern-military-strategy-lead-you-to-victory, retrieved on 18.12.2018.

Napoleon managed to win at Austerlitz²². But, most of the times, the battles were bloody and ended in an indecisive result; the wars were simple exercises of physical and psychological exhaustion and wear. As the war became total, the armed forces became more and more numerous and equipped with more and more powerful weapons, and the decisive battle became an increasingly difficult objective to achieve.

Up to a certain level, the naval fleets were also forced to fight at the tactical level of the war. Once the maritime superiority was conquered, the fleet could carry out several actions: blockades, bombing the fortresses near the shore, or amphibious operations. In case of blockade, the results were felt indirectly and after long periods of time; in the second case, the results were limited by the range of the anti-aircraft guns from the board of the battle ships. In the latter case, amphibious operations were, generally, only the prelude to ground operations – which brings us back to the cycle army – versus – army.

Air power changed the situation, narrowing the gap between the strategic and tactical levels. Aircraft can perform operations meant to achieve strategic-level effects. Airplanes eliminate the need to deal with land or environment problems due to their ability to fly over armed forces, fleets and geographical obstacles, hitting directly the key centres of a country. This capability offers alternatives to both bloody and prolonged land battles, and naval blockades.

Although the fighter aircraft and strategic bombers have the main roles in the development of air power, the helicopter is gaining more and more ground in this equation. As technology advances are implemented upon these platforms, and as the characteristics of classical conflicts are constantly changing, the helicopter is assigned increasingly defined roles in military operations, especially at tactical and operational levels.

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²² <https://www.historia.ro/sectiune/general/articol/austerlitz-batalia-celor-doi-imparati>, retrieved on 15.02.2019.



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The helicopter is in its fourth development stage, namely when weapon systems are developed, based on the use of the helicopter, which are able to act in an integrated manner, in at least two of the well-known domains of warfighting (air-land, air-water), by connecting them into in network.

From a historical perspective, most specialists²³ identify three distinct stages in the helicopter's military use:

- after 1940, the helicopter was used to support land forces being assigned to perform observation missions, logistic support missions or medical support missions;
- after the late 50s, both technological developments to which the helicopter was subjected and the tactical roles to which it was assigned created a necessary front in order to use the new weapon for combat support, all of which directly contributed to the manoeuvre of the supported forces, ensuring the movement of the troops and executing fire support;
- another stage is the one after the 1980s. This stage reflected the need to develop the concept of manoeuvre helicopters, combining both elements – the firepower and manoeuvre – based on the creation of independent and autonomous combat structures that became essential in the theatre of operations.

These stages developed more cumulatively than successively and once achieved each stage of development was never abandoned, but rather used as an extension of missions already assigned.

Mention should be made that, after the end of the Cold War and the increasing use of data transfer and satellite technologies, the helicopter is in its fourth development stage, namely when weapon systems are developed, based on the use of the helicopter, which are able to act in an integrated manner, in at least two of the well-known domains of warfighting (air-land, air-water), by connecting them into in network.

3.1. First stage – The role of supporting land forces

Although the helicopter was sporadically used for military purposes, including during World War II, for tasks like tracing cable telephony lines and supplying outposts/forward positions (the primary missions of the Sikorsky H4S and H5S helicopters purchased by the USA and the Great Britain in 1943)²⁴, we can say that specific military tasks were attributed to the helicopter by chance. This was due

²³ Etienne de Durand, Benoit Michele, Elie Tenenbaum, *Helicopter Warfare. The Future of Airmobility and Rotary Wing Combat*, Laboratoire de Recherche sur la Defense, 2012, <http://www.ifri.org>, retrieved on 30.01.2019.

²⁴ Matthew Allen, *Military Doctrines of Major Powers, 1945-1992*, Westport CT, Geernwood Press, 1993.

to the deprivation of the United States Army Air Forces (AAF) of the aircraft used successfully during the Second World War, deprivation caused by the restructuring of the United States Army and the creation of United States Air Force/USAF.

USAF was created by the “National Security Act of 1947”²⁵, which established the reorganisation of aviation structures into the U.S. Air Forces (USAF) and U.S. Army Air Forces (USAAF), the latter being part of the U.S. Army. Therefore, USAF started to be a distinct category of the US Armed Forces Structure that took over the Strategic Bombing and Heavy Transport missions, as well as those specific to gaining and maintaining Air Supremacy.

Following the reorganisation, USAAF kept a small, insignificant fleet, which consisted of a small number of aircraft tasked with Troop Transport and Close Air Support/CAS missions. Gradually, the US Army almost completely lost the control of the AAF fleet, having left only a few air assets to carry out observation missions and artillery fire guidance.

Focused on the Bombing Campaign in North Vietnam, USAF neglected the need for CAS and light tactical air transport, thus allowing the USAAF to invest the resources allocated in their own helicopters, transforming and developing the helicopters fleet missions. It was also established the number of helicopters necessary to create a fleet able to meet transport needs. This was the tactical justification of the necessity



The widespread use of combat helicopter began in the Vietnam War. Until that time, helicopters were mostly used to transport troops, identify and evacuate the wounded.

²⁵ U.S. Army, *Army Aircorps*, <http://www.army.mil/aviation/aircorps>, retrieved on 21.01.2019.



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Once USAAF identified the important role that helicopter can play, their leaders requested the expansion of its capabilities in order to be able to transport troops at large distances.

and emergence of the Air Mobility concept, which in fact represented the substantiating of the helicopter procurement program developed by the USAAF to this purpose.

Once in use, but also due to its unique flight characteristics, the helicopter initially provided the troops with the freedom to act regardless of the landscape barriers and independent of terrestrial infrastructure.

This stage demonstrated that the helicopter can successfully carry out support missions, showing, however, some limitations such as payload and cabin volume.

Undoubtedly, the most important field where the helicopter was used during this period was medical evacuation. The helicopter allowed the US Medical Service Corps to rescue the pilots who crashed over Bruma city in 1946²⁶.

Once USAAF identified the important role that helicopter can play, their leaders requested the expansion of its capabilities in order to be able to transport troops at large distances. A commitment signed on 4 November 1952²⁷, by which the dimensions that could be achieved by the USAAF aircraft were limited, prevented the services from using helicopters with appropriate dimensions for this type of mission.

Along with the continuous improvement of the platform itself and due to the technological revolution, the helicopter was permanently able to adapt to the learned lessons from each conflict in which it was used.

3.2. Second stage – Combat support role

USAAF played a key role in rapidly adopting the helicopter (from its original destination – transport) among the armed forces and assigning it on combat missions specific to the USAF, namely the CAS, and that was due to the faster understanding of the importance of its use, but also due to the limited CAS support provided by USAF²⁸ despite the fact that the helicopter was more vulnerable to the fire from ground based weapons, much more expensive and the assumed losses were much

²⁶ Otto Kreisher, *The Rise of Helicopter during the Korean War*, in *Aviation History*, 2007, <http://www.historynet.com/the-rise-of-helicopter-during-the-Korean-War.htm>

²⁷ *Office of the Historian. Kennan and Containment, 1947. Milestones: 1945-1952*, <https://history.state.gov/milestones/1945-1952/kennan>, retrieved on 10.01.2019.

²⁸ Morton and David Halperin, "The Key West Key", in *Foreign Policy*, No. 53, 1983, <http://www.jstor.org/stable/1148563>, retrieved on 02.01.2019.

higher than those of the fixed wing aircraft.

The technical characteristics of the helicopter to hover at low and medium altitudes, and the extraordinary field of view provided determined the Land Forces to see it as/the ideal platform to provide fire coordination missions for its artillery, thus not having to expose the controllers in the forward area.

The helicopter's utility in force projection was identified by US Marine Corps as a component of battlefield preparation by concentration of forces, an action inherent in the landing execution in expeditionary missions, where the bridgehead could not be made directly from ships. In November 1948, the Quantico Academy published a doctrine draft called Phib31 Amphibious Operations – Employment of Helicopters, introducing the term “vertical assault”. Several years later, USAAF adopted “Airmobility Doctrine”²⁹.

The advantage of mobility is not only providing the ability to transport and support forces, but also it sets the tempo of combat. Mobility offers to the one who possesses it, the ability to seek out the opponent, to follow and surprise him by applying fire and engaging into combat the amount of forces needed at a chosen time and place. Due to its potential to quickly change the balance of forces and to destabilise the opponent, mobility exerts a dual effect in the physical and psyche of the troops, materializing in two diametrically opposed directions. This explains the success and the decisive historical role previously played by cavalry³⁰ at its moment of glory and later by the mechanised/tracked infantry – the tank brigades.

Air mobility was systematically used in combat for the first time by the ALAT³¹ (Aviation Legere de l'Armee de Terre) in the Algerian War, as a tactic against the guerrilla war, highlighting the helicopter's ubiquity as a tactic against the strategic disadvantage represented by the asymmetry of this new type of war.

Therefore, we can state that the use of the helicopter caused the need to develop the concept of air mobility.

Subsequently, based on lessons learned from the Vietnam War, where the USAAF were forced to apply the “search and destroy” tactic,

The helicopter's utility in force projection was identified by US Marine Corps as a component of battlefield preparation by concentration of forces, an action inherent in the landing execution in expeditionary missions, where the bridgehead could not be made directly from ships.

²⁹ Rodney R. Propst, “The Marine Helicopter and the Korean War”, Combat Studies Center, 1989, <http://www.globalsecurity.org/military/library/report/1989/PRN1.htm>, retrieved on 28.01.2019.

³⁰ www.hexapolis.com-10-greatest-battles-won-against-overwhelming-odds, retrieved on 13.12.2018.

³¹ Etienne de Durand, Benoit Michele, Elie Tenenbaum, *op. cit.*, retrieved on 30.01.2019.



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The most ambitious concept of helicopter use was that of U.R.S.S. in the war in Afghanistan. Performing manoeuvre based on helicopter use was deepened and developed in the most extensive context by the Red Army. Russian strategists.

Russian strategists were able to accurately estimate the vulnerability of the tank to the use of ATGM/Anti-Tank Guided Munitions, and that of aircraft performing CAS to surface-based air defence systems from successive alignments.

the US launched the “Advanced Aerial Fire Support System”, program known as the 1964 Attack Helicopter Program, which resulted in the first attack helicopter – AH-1 Cobra in 1967.



AH-1 Cobra

Further, in a higher phase, the helicopter was transformed into a combat system, the technological development based on this type of platform leading to the creation of autonomous airborne forces.

3.3. The third stage – Manoeuvring role

The most ambitious concept of helicopter use was that of U.R.S.S. in the war in Afghanistan. Performing manoeuvre based on helicopter use was deepened and developed in the most extensive context by the Red Army. Russian strategists based their theory on the lessons learned from the analysis of the Yom Kippur War. Thus, they were able to accurately estimate the vulnerability of the tank to the use of ATGM/Anti-Tank Guided Munitions, and that of aircraft performing CAS to surface-based air defence systems from successive alignments³². The Red Army had 20 air assault brigades consisting of Mi-8 and Mi-24 helicopters and infantry originating from parachutists and motorized infantry, both in an organic scheme. Thus constituted, these brigades acted at a certain tactical-operative level, completely different from the level at which the airborne divisions were acting, in order to occupy strategic positions in the theatre of operations outside

³² Richard Simpkin, *Race to the Swift. Thoughts on Twenty-First Century Warfare*, Brassey's Defence, London, 1985.

the range of helicopters. Focused on the deep attack procedure, these forces successfully penetrated the opponent's defensive system and their main objective was to surprise and isolate significant amounts of enemy's forces in order to alter the balance of forces in a certain area of operations.

The subsequent emergence of the air-land operations doctrine that had a much more offensive character and which involved much faster ongoing combat actions also assigned a role in this type of operations to the helicopter. However, the architecture of the new war theatre did not allow the newly developed AH-1 Cobra to hit targets in the depth of the enemy territory. As the technological development advanced, in 1984 the multi-role attack helicopter was developed, AH 64 Apache³³, with superior autonomy which gave it the possibilities to hit the objectives considered priority from depth of the enemy territory.



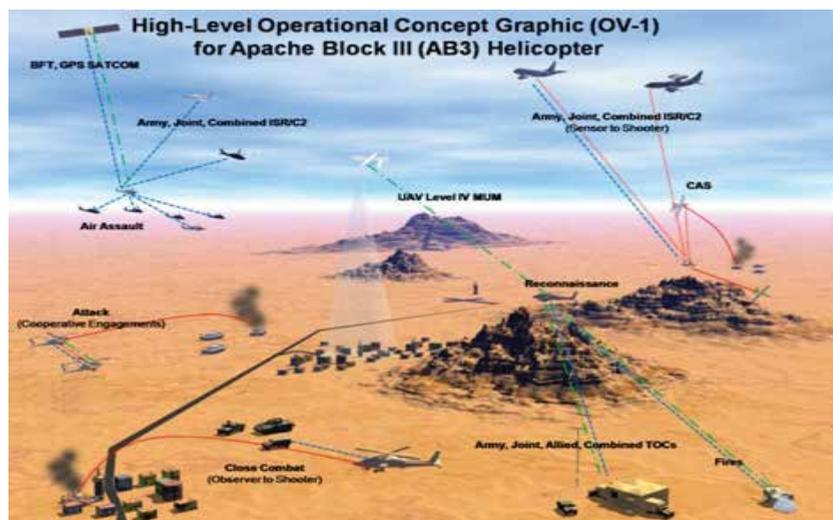
AH 64 Apache

The helicopter gained the role of modelling the battlefield and, supported by an appropriate doctrine, it is seen as the perfect antidote especially against heavy forces that were formed on the skeleton of armoured, mechanised and tanks brigades.

³³ <https://www.boeing.com>, retrieved on 01.02.2019.



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All the above-mentioned features, in the context of the technological evolution in the field of information transfer, as well as the use of satellite technology, place the helicopter at the core of certain combat employment advanced operational concepts, by which the helicopter is assigned multiple roles upon taking off.

3.4. The fourth stage – The current multi-role and multi-domain use

All the above-mentioned features, in the context of the technological evolution in the field of information transfer, as well as the use of satellite technology, place the helicopter at the core of certain combat employment advanced operational concepts³⁴, by which the helicopter is assigned multiple roles upon taking off.

Thus, today, the helicopter takes off with weapons onboard, equipped and capable of precisely engaging in combat:

- surface ships in self-defence against air threats;
- submarines in self-defence against air and sea threats;
- all kinds of land combat means, in self-defence against air threats;
- air-to-ground attack means going at low speed, in self-defence against ground-to-air defence.

In order to provide these roles, the helicopters operate together with unmanned or hybrid air vehicles (with mixed manned/unmanned crew), are provided with own and enemy forces tactical situation awareness systems (such as the Blue Force Tracking system). At the same time, they are provided with tactical data and information by ISR/C2-role aircraft and land sensors. The integrated use of the

³⁴ https://dodcio.defence.gov/Library/DoD-Architecture-Framework/dodaf20_ov1, retrieved on 04.02.2019.

helicopter in such a network enables it to be the first one to track the enemy, to understand the tactical situation, to take action and deal with the tactical situation much more efficiently than it has ever been able to do it.

4. The interaction between strategy and technological revolution in the helicopters field

The relations and influences between technology and strategy in the contemporary period are generated by the documents that determine the way of planning a state's defence, namely: National Defence Strategy, Government's White Paper, Military Strategy, Global Strategy etc. In most situations, highly developed states include important chapters of these planning documents which describe the defence system of that state as being based on weapon systems in the project stage or just in the conceptual stage. See the anti-missile shield (in 2007), Future Combat Air System Technology Initiative, "Joint Multirole Helicopter" (JMRH), AFVG (Anglo French Variable Geometry) and more.

This type of approach involves the development of a complex and sophisticated chain. Following the analysis of the potential military threat and weapon systems held by it, there are established strategic objectives and operational requirements for weapon systems that will be further developed to achieve these goals by neutralizing identified threats and achieving a favourable degree of control of the battlefield from a technological perspective. These requirements are then assigned to the profile industry specific of each system that is intended to be built, so that industry can then direct its research and development efforts to the areas where it was guided.

We will further focus on the relationships between technology and strategy in terms of the implications of the developed strategies on two of the current technological initiatives.

4.1. Joint Multirole Helicopter – JMRH

If in the past the success of using the helicopter in combat was based on the use of a platform specialised in different types of missions, a new concept is increasingly being discussed today – JMRH. Following the logical thread in which this new concept is expected to evolve from a technological point of view, it is expected that the specialized



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Although nowadays there are military concepts such as Air Assault that cannot be imagined without the simultaneous, integrated and coordinated participation of the three types of platforms, it is expected that JMRH will be able to execute independently and under more advantageous conditions the missions and typology of this concept.

helicopter fleet to be replaced by a new weapon system called the *Future Vertical Lift – FVL*³⁵.

The expectations of specialists in the field of system performance, beyond keeping well-known helicopter attributes, are aimed at bringing extra speed, increasing the transport capacity, increasing the fire power, extending the range of action, a higher survival level of the crew in the battlefield and, most important, bringing the level of maintenance and use costs to the lowest possible level.

The idea of this project has, of course, started from the need to rejuvenate the helicopter fleet of the world's largest helicopter operator, the United States Army. The overwhelming majority of the helicopters of this impressive fleet is, however, represented by adapted and/or upgraded variants of the base models Black Hawk, Chinook and Apache.

Although nowadays there are military concepts such as *Air Assault* that cannot be imagined without the simultaneous, integrated and coordinated participation of the three types of platforms, it is expected that JMRH will be able to execute independently and under more advantageous conditions the missions and typology of this concept. Hence, after the NH 90/NATO Helicopter 1990 project, the specialised military constructing industry intends to build a vertical take-off and landing aircraft, on a completely new structure. Considering the physiognomy of current conflicts and the particularities of conflict environments, the US Army plans to develop this program, taking into account all possible variables.

Following the experience accumulated from participating in most armed conflicts that followed World War II, the formulation of the operational requirements consisted most likely in transposing over time all the deficiencies of the most famous platforms used in these conflicts. Along with the technological evolution of weapon systems used in air defence and the infinite tendency to identify and assign new and more complex missions, these platforms have progressively shown their weaknesses reaching a level which is not adequate for satisfying the mission requirements specific to the contemporary theatre of operations.

³⁵ <http://www/ivertical-lift.org>, retrieved on 01.02.2019.

Operational requirements underlying the project include³⁶:

- a minimum transport capacity of 12 fully equipped soldiers;
- a crew consisting of four members;
- the possibility of executing a stationary flight without ground-effect at an altitude of 2,000 meters and 35 degrees Celsius;
- a maximum flight distance of 3,500 km with a speed of 430 km/h;
- the dimensions of FLV may vary according to the mission specificity, but major mechanical equipment and assemblies such as the rotor, landing gear, engines, power installations and cockpit equipment need to be common and interchangeable;
- the new capabilities offered by the FVL's high aerodynamic performance and meanwhile enhanced by the facilities offered by the avionics systems shall allow the FVL to perform a wide range of missions: reconnaissance; anti-submarine and anti-surface combat; special amphibious assault operations; medical and non-medical evacuation; ISR; SAR; C2; CSAR; attack; logistic support and transport.

The FVL concept is also based on the idea that the same type of aircraft will be used to carry out a wide and complete range of missions³⁷. According to the concept, it is expected that this will lead to the use of a low number of aircraft types with an impact on logistic efficiency (maintenance costs, low associated industrial risks, etc.).

The development of this concept has started from the requirements of the new US National Defense Strategy, which estimates that modern wars can be won both on land and above water, in space or in cyberspace or abstract environments. The new FVL platform shall be equipped, shall cope and align with all of this multi-domain battle challenge.

Thus, the priority of the program consists in developing a platform capable of acting in missions of reconnaissance and attack in connection with unmanned aerial vehicles, but at the same time being able to perform some air assault missions from a very large distance.

The FVL concept is also based on the idea that the same type of aircraft will be used to carry out a wide and complete range of missions. According to the concept, it is expected that this will lead to the use of a low number of aircraft types with an impact on logistic efficiency (maintenance costs, low associated industrial risks, etc.).

³⁶ [csis.org/events/future-vertical-lift-insights-joint-multirole-technology-demonstrator](https://www.csis.org/events/future-vertical-lift-insights-joint-multirole-technology-demonstrator), retrieved on 28.12.2018.

³⁷ [defensenews.com/digital-show-dailies/global-force-symposium/2018/03/30/army-future-vertical-lift-hones-in-on-attack-recon-long-range-assault/](https://www.defensenews.com/digital-show-dailies/global-force-symposium/2018/03/30/army-future-vertical-lift-hones-in-on-attack-recon-long-range-assault/), retrieved on 19.12.2018.



If until now there were taken considerations air assault missions which took place near the contact line or even beyond it, from this point on the first expected impact at the doctrinal level, along with the realisation of the FVL, is that the mission shall be carried out from its own territory, without any need for air protection, from distances that no longer need fire support and increased payload capacity. This will undoubtedly lead to the design of another defence architecture, to the development of other air defence modalities of its own territory, and the emergence of new forms of attacking objectives behind enemy lines.

The estimated industrial impact generates debates that are far from ending regarding the type of helicopter that will be replaced by the FVL, namely the Black Hawk helicopter or the Apache helicopter.

The US National Defense Strategy prioritises the lethality of the weapon system, and the arguments presented by supporters of the idea of increasing the lethality of combat actions through air strikes or those raised by supporters of the idea of increasing lethality by enhancing special capabilities for air strikes should be taken into account.

Based on these debates, the two major US airline manufacturers, Bell and Sikorsky-Boeing, offered two important proposals for the project, namely: V-280 Valor and SB-1 Defiant³⁸.

Valor version, which has wings, is more fuel efficient, which translates into increased flight autonomy and within a range of much more action.



V-280 Valor

³⁸ www.breakingdefense.com/2017/10/bell-v-280-vs-sikorsky-boeing-sb1-who-will-win-future-vertical-lift, retrieved on 28.01.2019.



SB-1 Defiant

The Defiant variant equipped only with rotors is much more agile, so it can be operated in restricted spaces and manages to use field camouflage much more efficiently.

The operational requirements of this new FVL concept consist in overcoming the limits imposed by materials physics and aerodynamics of already existing systems on the market. The operational requirements of this new FVL concept consist in overcoming the limits imposed by materials physics and aerodynamics of existing systems on the market today. At present, both companies agree that the V-280 Valor version, which has wings, is more fuel efficient, which translates into increased flight autonomy and within a range of much more action than its rival, who only has rotors to generate the force of sustainability.

At the same time, the Sikorsky-Boeing builder mentions that the Defiant variant equipped only with rotors is much more agile, so it can be operated in restricted spaces and manages to use field camouflage much more efficiently (hills, valleys, infrastructure elements and vegetation) in order to avoid discovery. Despite the constructive differences, the main strengths of these two aircrafts are common and can be identified by the parameters of speed, range and flight level. Regardless of the model that will be chosen for the development of the new concept, the program is an example of how military strategy can influence and contribute to technological development.



The primary purpose of the invention is to provide an engine that combines the qualities of four-stroke classical motors with the advantages of rotational motion and the advantages of a variable compression ratio in order to increase efficiency, reduce vibration and reduce engine volume and mass.

4.2. Implications of the technology revolution on strategy – the MRAI4T engine

In opposition to the process presented in the previous subchapter, where the technological revolution is mainly generated by the objectives of the military strategies, the military strategy was almost always revised during the period before the end of the Cold War due to the emergence of new weapon systems and the experiences resulted from their experimental or accidental use in conflicts.

Although the particularities of today's relations between the technological revolution and the military strategy are particularly subordinate to strategic planning documents, there are also potential situations, although isolated, where the technological revolution determines or can lead to the adaptation of military strategies.

Such a possible example can be found, in the form of a project, at the State Office for Inventions and Trademarks from Romania³⁹, called the *four-stroke internal combustion engine* (MRAI4T). We chose to create a scenario whereby such an invention can generate influences on the current military strategies, although the project of the young Romanian inventor does not have impressive budgets such as the JMRH, nor the promotion or the industrial support.

The invention refers to an internal combustion engine which is intended for the means of transportation, having the capability of stationary engine mode. The primary purpose of the invention is to provide an engine that combines the qualities of four-stroke classical motors with the advantages of rotational motion and the advantages of a variable compression ratio in order to increase efficiency, reduce vibration and reduce engine volume and mass.

From a strictly technical point of view, the internal combustion engine solves the problem of limiting the power increase of the classic engines, which is their weakness, by summing up the forces that appear on the surfaces of the pistons directly to an output shaft.

However, analysing from a military perspective the three pillars on which an army is based (the human pillar, the technical pillar

³⁹ <https://inregistrare-marci.ro/verificare-marca-inregistrata-OSIM-EUIPO-WIPO-BOIP.php>, retrieved on 09.02.2019.

and the doctrinal pillar), it is considered that there can be obtained some important advantages by implementing this invention as follows:

❖ **for the human pillar:** simplifying the selection system, general training and the special training of technicians due to the reduction in the used number of engine types; reducing the staff required for operation, maintenance and repair; easy dissemination of knowledge and experience between staff operating the MRAI4T engine;

❖ **for the technical pillar:** easy handling of the speed and torque range by choosing a ratio between volume and different diameter in the MRAI4T engine manufacture; increased yield; increased durability; reduced size; low weight; reduced number of components; low noise level; lack of vibration; an increased ratio between power and mass and between power and gauge; low production costs; low fuel consumption; the possibility of using more sources of energy and fuels while performing the same mission; low noxious emissions;

❖ **for the doctrinal pillar:** possibilities of using the combat system based on the operation of the engine type in different environments (air, water, space) due to the operation of the multi-combustion; the reduced out-of-order time for maintenance leads to a high availability of the MRAI4T engine based weapon system, with a sustained battle pace; reducing the size of the weapon system based on the MRAI4T engine due to the simplification of the power transmission system to the aircraft command and control equipment; interchangeability of the entire engine or at least of the main components which increase the reliability of use and provide a high degree of maintenance; the reduced size and weight allow to increase the weight of the weapon system based on the MRAI4T engine; low thermal, noise/phononic and radar signature.

Taking into account the expected and presented advantages presented by each of the three pillars, it is easy to deduce that there can emerge important changes following the eventual implementation of this innovative idea in terms of the military strategy.

If the project is developed, there are inevitable important changes regarding the military strategy, such as the development of multi-domain models of weapon systems based on the MRAI4T engine. Given the characteristics and performance above mentioned and taking into account the model of amphibian conveyors (which have terrestrial



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and aquatic fields of action), there can emerge and develop new weapon systems that can operate in a combination of at least two of the following fields: ground, air, underwater or space.

It also should be taken into account the redefinition of limits and restrictions imposed by large geographical distances, by the environmental and climate conditions, by the existence or lack of oil resources and processing facilities. These limits will be easily overcome or even ignored in planning future operations.

Based on the use of the multi-combustion and on the increased independence from the fossil fuel facilities and infrastructure (generally used today to ensure propulsion), the weapon systems that will use the MRAI4T engine will thus change the physiognomy of Expedition Operations.

Based on the use of the multi-combustion and on the increased independence from the fossil fuel facilities and infrastructure (generally used today to ensure propulsion), the weapon systems that will use the MRAI4T engine will thus change the physiognomy of Expedition Operations.

4.3. Development through assimilation and adaptation

Another form in which the technological revolution influences the military strategy is represented by the situation where a state that does not have the necessary resources and infrastructure or access to the most technologically advanced level after the emergence of different technological developments and the adaptation of the strategies in partner states or other more technologically advanced and economically and technologically potent states, develops or assimilates similar technologies, and adapts strategies and doctrines in line with it.

This is the case of the Romanian Air Force, which, in order to prevent the Degraded Visual Environment-DVE, carries out a program of revitalisation and modernisation of the IAR 330 L helicopter fleet. An enhanced video image, the new system configuration and cockpit architecture will allow the application of techniques, tactics and procedures specific to the average helicopter under the conditions of piloting benefits in line with the most up-to-date principles: “Head-up”, “Hands on Controls”, “Eyes-out” and “Piloting on FLIR”.

Since, following the upgrading program, it is estimated that helicopter navigation and pilotage capabilities will be greatly improved, FAR is expected to adapt the helicopter use doctrine to operations that meet the characteristics and performance of a more versatile helicopter with increased mobility and flexibility, with extra speed, but also less vulnerable and harder to be surprised.

5. Conclusions

The intrinsic relationship of the human civilization evolution reported to the evolution of armed conflicts, resulted in an association of each element of the modern security systems with a doctrinal element that can undergo changes or adaptations according defence needs. The function thus generated between the two sets of components, acts and reacts with the evolutionary trend of each component.

The current trend, most likely due to the need to stimulate the business environment, is to develop military strategies based on weapon systems that are still in the project stage but which, in most cases, depending on the success or failure of the weapon system development initiative, must be reviewed or, in some cases, even abandoned.

Unlike the situation where the developing weapon systems are designed as a result of designing long-term military strategies, the technical solutions developed in a short term, which did not originally turn into a weapon system, are introduced into use either under confidentially terms (for their experimental use until the adaptation of the military strategy), or once publicly available information on the technical solution, they are experimentally introduced in the defence system to find the real purpose that changes the military strategy.

The helicopter, as a means of air combat, was initially designed when conflicts were conducted through extensive campaigns involving huge territories, conventional armed forces, and when opponents were relatively equally endowed and behaved relatively predictable. Initial helicopter use, however, was done by commanders trained on conventional warfare instructions, and against unpredictable, hard-to-identify adversaries who used unimaginable techniques, tactics, and procedures in the sphere of conventional warfare. Military strategies based on the use of helicopters in specific missions have been permanently adapted precisely for this reason.

Without neglecting its extremely important role in bringing together human, financial and technological resources around the weapon system, developing a military strategy based on weapon systems still in project stage can also have negative effects. By initially imposing the characteristics of the weapon system at the initiative stage, a system of limiting the performances of the weapon system is involuntarily

The current trend, most likely due to the need to stimulate the business environment, is to develop military strategies based on weapon systems that are still in the project stage but which, in most cases, depending on the success or failure of the weapon system development initiative, must be reviewed or, in some cases, even abandoned.



induced or inappropriate fields of use impede the exploitation of the product to its maximum performances in the contemporary combat theatre architecture.

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