

CONCEPTUAL PROJECTIONS ON NATO MEMBER STATES' AIR FORCES TRANSFORMATION

Cosmin-Liviu COSMA

“Carol I” National Defense University, Bucharest

Abstract: *Since the end of the Cold War to the present, NATO has been involved in a significant number of military operations, which have shown the appetite of the decision-makers and Western military leaders regarding the use of air power as a weapon of choice. However, as demonstrated by some recent counterinsurgency operations, the air instrument is not always effective (or effective), being very situational, regarding the circumstances.*

This reality is the starting point in examining options, limitations and shortcomings in order to develop the concepts that provide the intellectual framework for establishing new transformational capabilities, that once implemented on the force structure, will allow the management of the challenges of an unpredictable, uncertain and in a constant metamorphosis security environment.

Keywords: *military transformation, air force, NATO*

1. THEORIES ON NATO'S MILITARY TRANSFORMATION

The processes in the Euro-Atlantic military structures were involved are known as **transformation**, its character **being one evolutionary rather than revolutionary**.

Its associating has been made with the appearance of the **Military Technological Revolution (MTR)**, developed by Russian Marshal Nikolai Ogarkov, which was then transformed into **Revolution in Military Affairs (RMA)**.

Regarding transformation process, there are two schools of thought, the first identifying with the Revolution in Military Affairs, and the second one being a process able to provide solutions to the unpredictable security environment of the 21st century.

In other somewhat similar interpretations, as is the on by the U.S. Department of Defense, the transformation occurs in two separate directions, but interconnected.

The first is represented by **the transformation of forces from the industrial age to the informational age**.

Its main characteristics are the technological advances in information area, collection and information assessment, command and control, but also the very high degree of kinetic precision and non-kinetic weapons that have dramatically reshaped the nature of war. Acquisition, sorting and allocation processes of targets to be hit will take place instantly, the effects being tracked in a qualitative and not quantitative way. New operational reality is different, the execution of leading surgical strikes will take the opponent out of battle rather than physically destructing him.

The forces involved are small, destruction and collateral damage being minimal. The forces involved are small, collateral damage and losses will be minimal. *“In the context of air operations, power application at the right place and time is a concept associated with effects-based operations. This first transformation form of expression is identified by some scholars with the Revolution in Military Affairs”*.

The second form is represented by **transformation of the Cold War specific forces into forces adjusted in accordance to respond the current security environment**.

The objective of this transformation process is to create forces able to address current and future security environment threats (terrorism, air and space attack on the air and space platforms, cyber attacks, the use of cruise and ballistic missiles and chemical, biological, radiological, nuclear attacks etc.). Also, these new forces should be able “to conduct peace support operations, defend national territory, and conduct stability and low intensity conflict areas operations”.

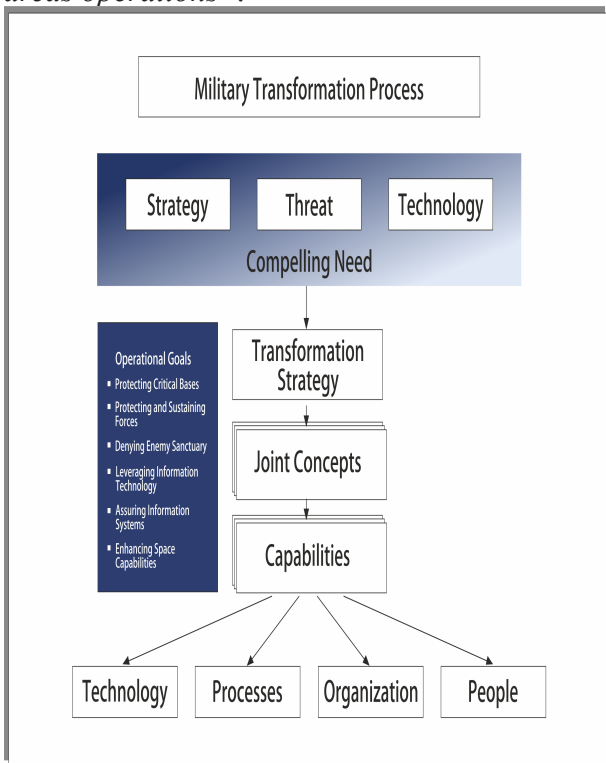


Fig. 1 – Military Transformation Process (source: U.S.DoD, “Military Transformation – A Strategic Approach”, Washington, 2003, p.13)

Due to various circumstances, the term **transformation** has different connotations, depending on the individual, organization, category of forces, or the country where the service is subject to debate. In essence, according to some theories of organizational transformation process, there are three different meanings of the term **transformation**: “(1) The change of external appearance; (2) The change (more subtle and complex) of the condition or function – a conversion into something else; and (3) The change in personality or character entities.”

From the US perspective, the process of military transformation (Fig. 1) begins with strategy, threats and technology analysis, as determinant factors in transforming the force, and the six operational objectives identified in the report QDR 2001. Transformational capabilities “will be achieved once the development and experimentation results are implemented on the established military forces elements”.

Depending on the particular context (and the level of ambition), most of the processes that were committed in various air force, were limited to the first sense of the concept. Thus, these forces were upgraded, renewed or reformed, focusing on the technological aspect, the transformation occurring in the structures of command and control, communications, respectively in the acquisition and equipping with new equipment to create new actionable capabilities, or expand their existing ones. Despite this, efforts have been made towards the implementation of changes at the organizational doctrine to force transformation.

If for the U.S. Air Force, the **transformation** is “a process through which the military gains and maintains an advantage through changes in operational, organizational and/or technology concepts, which significantly improves combat capability or the ability to respond to a constantly changing security environment”, for NATO this expressed by the statutory mission *Allied Command Transformation (ACT)*: “ACT will be the driving factor of change; it will allow, facilitate and advocate for continuous improvement of military capabilities to enhance the interoperability of military importance and effectiveness of the Alliance.”

The reference document of the U.S. Secretary of Defense – **Transformation Planning Guidance (TPG)** – considers **transformation** to be “a process that shapes the changing nature of both the military competition and cooperation through new combinations of concepts, operational skills, human factor and organizations that exploit the advantages of the nation and provides protection against asymmetric vulnerabilities to preserve the current strategic position.”

Even though the two theories are not mutually exclusive, and identifying areas of congruence, however these approaches are natural reflection of domestic factors pertaining to specific organizations, regarding the concepts or objectives that aim to be achieved through this process of transformation.

While the US Department of Defense vision on transformation is seen from a procedural perspective, integrative, redefining the standards to achieve military success to their specific operational environments involving large innovative processes in the NATO sense, valences are rather Holistic highlighted the need to fulfill certain performance criteria, measurable result by satisfying critical conditions, the existence and operation of transatlantic organization as a whole. Thus interoperability or superior military capabilities are key factors in achieving military objectives as part of the functionality Alliance. One of the areas of congruence derives precisely from the relation of subordination / conditioning of operational capability and interoperability, the reference being to reduce the gap between US and European partners, considered still an open question.

2. CONCEPTUAL PROJECTIONS OF AIR FORCE TRANSFORMATION

2.1 New threats, new concepts, new roles of the Air Force. While current security environment features – fragmentation, non-linearity, unpredictability, multiple asymmetries, terrorism, crime and extreme violence – are the image of a new kind of war, **globalized and interconnected**, the ones associated to future threats are the stochastic coordinates (random, probabilistically and statistically modeled) of complex visionary constructions based on “*estimates of events’ evolutions*”, hard to manage due to the “*huge volume of data and the high degree of uncertainty*”.

Briefly stated, these are characteristics of the current and forecasted confrontation environment in which the Air Force – through its undeniable attributes – is forced to act, by being

“the tool of choice in the contemporary era, when Western politicians and military commanders need to collect information and wish to react, to project power and to win wars. From another perspective of the spectrum of conflict, airpower can put pressure on the diplomatic approach, as they may act to punish countries that support terrorism.”

If in the Riga Summit in 2006, the North Atlantic Council (NAC) has emphasized the coordinates of the new context created by the multiple threats to the security of allies, highlighting the global influence of these opponents unpredictable actions: “*NATO members are faced with complex threats, sometimes under direct relationship, such as terrorism, manifested on a global scale, with fatal results, the proliferation of weapons of mass destruction, respectively the instability generated by failed states*”, in Bucharest in 2008, NAC advanced the idea that alliance members must ensure those “*appropriate capabilities necessary to meet the new challenges of the XXI century and to succeed in this endeavor, being necessary transformations, adaptations or recast as necessary. Transformation is a continuous process and requires constant and active attention*”. The urgent need to develop new military capabilities adjusted to the new security context has been discussed in the NATO Summit in 2002, when, by signing the **Prague Capabilities Commitment**, Alliance members expressed their consent on further action to transform national defense systems in order to obtain greatly improved defense capabilities. Addressing the generation of forces is based on specific capabilities, both the US and NATO, thus designed to provide the necessary means for transformational concepts and operational requirements metamorphosis in skills, capacity to generate effects in theater, in order to address current and future threats. From this new perspective, through joint, combined and multi-agency action, as the norm of contemporary military operations of NATO, the air forces are involved in missions whose main objectives are: (1) **Ensuring the territorial integrity, sovereignty and political independence**; (2) **Ensuring the capability to respond to crises throughout the full spectrum of operations**; (3) **Protecting strategic access and freedom of movement globally**

(space, international waters, air and cyberspace environment); and (4) **Promote order, peace, stability and security.** The establishment of an Air Force, shaped in terms of effects generation on adversaries capabilities, should meet requirements regarding the optimal size and shape, positioning within the defense system during operations etc. It also requires future concepts development and a shift in emphasis: (1) From single-focused threats – to multiple, complex challenges; (2) From nation-state threats – to decentralized network threats from non-state enemies; (3) From conducting war against nations – to conducting war in countries we are not at war (safe havens); (4) From major conventional combat operations – to multiple irregular, asymmetric operations; (5) From predetermined force packages – to tailored, flexible forces; (6) From massing forces – to massing effects; (7) From an emphasis on ships, guns, tanks and planes – to focus on information, knowledge and timely, actionable intelligence; (8) From static alliances – to dynamic partnership; (9) From focus on kinetics – to a focus on effects; and (10) From static defense, garrison forces – to mobile, expeditionary operations.

Along with operations conducted under NATO operational framework, integrated into Combined Joint Task Force (CJTF) or in NATO Response Force (NRF), conducted in the NATO Area of Responsibility (NATO AOR) or outside the AOR, the air force must be able to neutralize any adversary and control any situation across the full spectrum of operations, from collective defense to counter-terrorism, from countering aggression and peace enforcement to humanitarian and military support operations.

Future air forces should be able to perform various operations regardless of location and time of deployment, whether it is an urban environment, obstructed coastal areas, austere or remote locations.

2.2 Forms of adaptation of the Air Force.

The entire evolution of air power was the result of a long process of transformation, both institutional and at the endowment level, due to technological progress and infusion of new concepts. There remains pertinent the debate created around the validity of institutional adaptation options, around ways of expression and how they can change the conduct of the fight against threats of 21st century.

In its study on the use of air power against new threats, as asymmetries, terrorism etc, the French author Jean-Jacques Patry emphasizes the existence of two forms of adaptation. The first one, known as **direct form**, involves converting air power in aerospace power, and the second one, as **indirect form of adaptation** referring to the development of special air forces (elements) (Fig.2).

Direct Adaptation. Classic air campaign, as those performed in Iraq and the former Yugoslavia, they were determined – at least for the United States – a fundamental change in the application of air power.

The United States define this aggregate as an aerospace power, representing “*the ability to use platforms operating in the aerospace, or the ability to permeate it for military purposes*”. This attribute is not the exclusive preserve of a single weapon, but of a whole ensemble increasingly integrated, whose effectiveness depends on the overall performance of weapons systems and the use of command and control architecture designed on network data management basis, aiming to provide an enhanced surveillance capabilities.

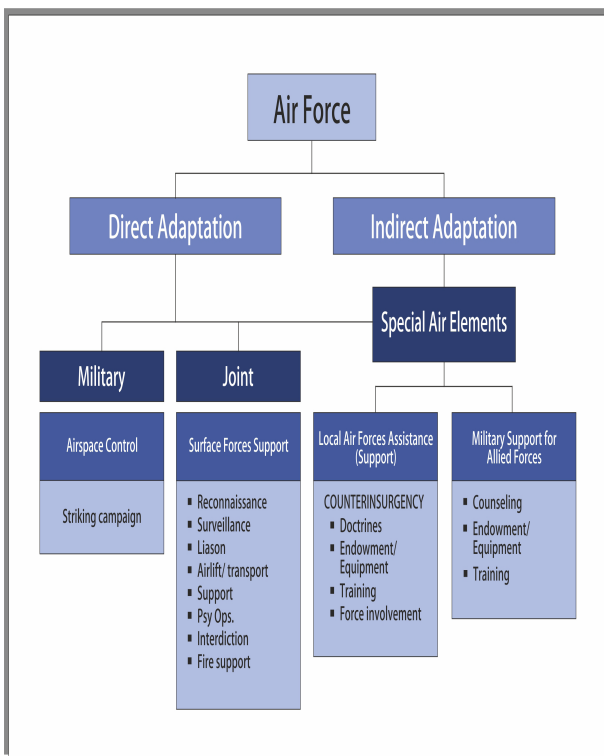


Fig. 2 – Air Force adaptation (sursa: Jean-Jacques Patry, “*L’ombre déchirée, la puissance aérienne contre la terreur*”, L’Harmattan, 2007, Paris)

This development is not the result of the fight against asymmetric systems, but rather that of some actions of industrialized nations, thought to neutralize an enemy rapidly, with acceptable human and material losses. In this case the debate is on the opportunity to address asymmetric threats, in the context of air power evolution to aerospace one.

A quick review of the main features of this development, for air operations justifies its role in the fight against collective unconventional armed violence, asymmetric, hybrid type, etc.

The core of this evolution lies in the maximum (and optimum) use of the third dimension, to monitor, analyze and generate effects on the adversary gravity centers (state institutions, economic production systems, armed forces units or operational facilities) as a strategic indirect approach, aimed at the destruction or paralysis of the opponents military power or political sources, so causing them to give up without armed resistance.

Indirect Adapting. One aspect of novelty of the last two decades in conventional campaigns is the development of special forces, their beginnings being found in the Cold War years in countries like the United States, the Soviet Union and Britain.

After the Gulf War, this type of force units was adopted by other countries like France and Germany, adapting it to other unconventional conflicts: Israel, South Africa, Colombia.

The best example of an indirect adaptation is provided by **Air Force Operations Command (AFSOC)** and its units through the wide range of features and missions they perform. AFSOC regroup at the end of 2000 around 13,000 combatants (and in 2010 around 15,000), 102 airplanes and 58 helicopters, being integrated for operations the **US Special Operations Command (USSOCOM)**, with responsibilities on planning, command and control, equipment and training for this type of operation.

Special Air Forces areas of expertise are numerous, they being able to ensure the implementation of all generic tasks set by US Special Forces USSOCOM.

A brief analysis allows the execution almost of all these missions in unconventional conflict spectrum, and while some of them -

Peace Operations, Humanitarian Demining, Humanitarian Operations, Civil Affairs, PSYOPS, Information Ops, Combat Search and Rescue (CSAR), Search and Rescue (SR) etc.

Thus, AFSOC has gradually formed a set of force intrusion in hostile territories capabilities, link/ liaison capacity, refueling and support in all weather conditions, regardless of the external environment, and able to provide adequate responses to extreme combat situations, throughout the full spectrum of operations, classic and unconventional.

These Special Forces capabilities, synergistically integrated with the effects provided by the air forces, confers increased tempo of operations, flexibility in use of forces and assets, as well as increased flexibility, acting against opponents significantly different in expression, if we consider the classic way of warfare.

Operational limitations of contemporary forms of adaptation. In the previous forms of adaptation presentation, the premises of the analysis were features and capabilities held almost singularly by American forces alone. For the other NATO countries' air forces, the problem can not be discussed as trenchant, no European state possessing such significant air and space power capabilities, similar to those previously described, and having no special forces strong enough to provide a consistent response to asymmetric threats at the operational level.

2.3 Air Force conceptual transformation. The purpose of defense transformation aims to ensure those skills (in the form of military capabilities), that will allow the military organization to maintain the ongoing initiative across the entire spectrum of conflict.

To satisfy the conditions favorable to this end, the developing of transformational concepts is one of major importance.

In this direction, the **Allied Command Transformation (ACT)**, as an enabler force for change, developed a methodology to generate the NATO necessary military capabilities, configured in a manner to address new security context, known as **Capability Development Process**.

In order to achieve operational air forces operationally adjusted, suitably equipped, with a high degree of combat readiness, able to evolve in a complex environment, different in expression – at NATO planning and decision levels – the approaches are focused on determining the requirements imposed by development of operating concepts and Joint fulfillment of the roles built around various scenarios and missions. The **Future Concepts and Transformation Division** (US) through the reference document on the Air Force transformation – **The US Air Force Transformation Flight Plan** – drew a direction to follow, consisting of a set of clearly defined objectives: (1) cooperation with other services, defense departments in order to enhance the interoperability of the operations carried out within the joint and coalition framework; (2) continuing resolute implementation of innovations processes; (3) creating a flexible and agile organizations that facilitate transformation and culture change institutionalization; (4) the transition from planning threat-based and platform-based to effects-based, respectively to adaptive capabilities, through new concepts of the air force operations (CONOPS); and (5) developing operational capabilities to enable transformation objectives. Mostly, these objectives are part of organizational processes, which gives necessary dynamism to defense strategy, so being capable to address varied and ever-changing threats. Relationship between technological, organizational and doctrinal concepts is one of interdependence. Transformation is not just new equipment purchased, but has more complex implications, enabling at organizational the capitalization of technological advances. Mutual dependence is also supported by the statement that *“there is neither revolution in military affairs nor transformation, if new technologies are not incorporated into the processes of change in organization, doctrine, which, however, requires time”*.

For ensure the transformation conditions, there should be satisfied changes in both organizational culture and staff development models, to foster the Air Force transformation.

The next step is to adapt the organization with the aim to institutionalize this new culture.

A special importance is the development of concepts to enable the transformation of an Air Force organizational culture belonging to the Cold War into a new type of culture, specific of sufficiently flexible forces that can carry a wide range of operations, globally, in accordance with the current security environment operational tempo.

The organization, instruction/ training or endowment/ equipping are other issues linked with the conduct of operations outside the own air bases perimeters.

To maximize success in operations conducted outside the area of responsibility is required to set up structures to assist and support the allies to develop their own strong air forces, respectively: *“(1) the creation of new structures, which by its own control elements to plan and execute missions in expeditionary units framework; (2) the integration of the other categories of the air forces to achieve increased operational capacity in an efficient manner.”*

Another important aspect of transformation aims to develop management programs to put the right man in the right place at the right time, and programs that prepare tomorrow's modern leaders by providing education, training and necessary experience for understanding the dynamic security environment.

The **transformation** is supported by the institutionalized involvement of research centers and laboratories, the result sought being to implement innovative processes (**Air Force Research Laboratory and Product Centre, Air Force Battlelabs, Advanced Technology Demonstration** etc.) and emerging technologies. Thus, the research products are integrated into the operators' and strategic planners' products, aiming at achieving distinctive capabilities of future **operational concepts** (CONOPS).

Innovative ideas are then tested in simulation laboratories of the mission (**Battlelabs**), in order to test their applicability to the final integration. The aim of these tests and simulations is to generate operational and logistical capabilities that impact across the organization, doctrine, training mode, acquisition and equipping requirements.

Associated to transformation, the allocation of necessary resources for procurement becomes of strategic importance for defense under increasingly limited budgets. In both current conditions and those of future conflicts, quality parameters on development and equipping combat forces will remain the military effectiveness, defined as *“a process by which armed forces transform resources in combat capabilities. Those resources are: “human and natural resources, financial resources, technical potential, industrial base, government structure, social characteristics, political capital, intelligence of military leaders, namely the existence of moral.”* While a deeper analysis of military effectiveness involves assessing different factors such organizational attitudes, behaviors and relationship, it also implies the notion of **efficiency**.

Resource efficiency is one aspect that contributes to the successful completion of a set of military activities (process defining victory).

The weapons system the Air Force is supplied with – in order to progress in a security environment where technology is evolving at a dizzying pace – requires changing the purchasing and procurement processes conducted. It is necessary “to decrease acquisition cycle time and increase credibility in executing programs”. Complete review of guidelines governing the purchases must be supported by the application of principles based on innovative concepts, providing the necessary flexibility for rapid integration of emerging technologies into the system. An approach of this type, with an evolutionary character, meets the ultimate goal of creating desired effects in theater “with today’s technology today rather than with yesterday’s technology tomorrow”.

Other recent transformational concepts offset the enormous gap existing between the U.S. and its European allies, when it comes to participation (with material, human and financial resources) to missions where NATO is involved, by offering solutions. Thus **Smart Defense** released in 2010, is based on **cooperation, prioritizing and specialization**.

Acting smart to achieve these objectives, members of the alliance would be, amid the current economic situation, namely the reduction of defense budgets, to be able to “produce” security with limited resources.

Operationally, the transformation is designed to maximize the Air Force capabilities across the entire spectrum of current and future conflicts.

It is essential to maintain the superiority achieved, but it also requires the development of additional capabilities to meet future threats that are particularly complex: “(1) the expansion of action possibilities in worldwide operations; (2) The integration of airborne, space and information components in a synergistic manner to achieve operational advantage; (3) rapid projection of forces globally and in the airspace; (4) establishment of effects on demand anywhere, anytime; and (5) creation of simulators that can quickly and accurately replicate any theater of combat actions in the world by using specific tools to generate scenarios”.

Also, it is loomed that in the future the Air Forces will be able to integrate data sensors in real-time detection; exploit sensor networks to create sources of invulnerable information; use bio processing, nano information or develop the technology that enables synthesizing fuels, water etc.

In a new type of conflict, battlefield where armies are no identifiable physical footprint, “marked by nonlinearity and indeterminacy, chaos strategy, aerospace component becomes primordial role” aerospace power involvement may take the form of “missions external defense missions counterterrorism, counterinsurgency operations or the type of stabilization and reconstruction”.

Identifying, tracking and neutralizing these opponents become a priority task of the Air Force, by using the entire technological arsenal that it owns, together with the work of government intelligence and security agencies.

The result of joint efforts allows the execution of precise strikes on the center of gravity of these structures, whether state or non-state actor.

The recognized capability of the Air Force to execute surgical strikes is an invaluable asset in counterinsurgency operations, other advantages consisting in the execution of information operations, cyber intelligence, surveillance and reconnaissance and global mobility.

3. CONCLUSIONS

Transforming the Air Force requires a relevant reassessment of both the experience resulted from their involvement in recent conflicts, as well as theories developed in fields of theory and airspace strategy, resulting in integrated solutions in the development of operational capabilities necessary to combat future threats.

Distinctions between war and peace, nation and society, politics and economics, national, transnational and international, force and violence are blurred in this type of confrontation, resulting in mixed, hybrid forms, hard to identify and define.

In the process of transformation, **Revolution in Military Affairs (RMA)** provides “a consensus on what a modern army is: small and highly trained units, rapidly deployed and using information technologies, which are more flexible and more lethal”. RMA, as the last stage of military transformation is defined by five distinct characteristics: (1) doctrinal flexibility; (2) strategic mobility; (3) configurability and modularity; (4) the ability to act together and connectivity in an international environment; and (5) the versatility to operate in conflict and Operations Other than War - OOTW.

In other words, modern military forces of the 21st century must be a **versatile mix of adjustable organizations** structured “in a rotational cycle, which provides ready to act in the full spectrum of conflict forces”.

being able to provide effects in various unpredicted contingencies.

It is therefore vital that the changes they undergo structures coalition forces and means to be significant, causing air forces to obtain flexible, proactive, larger capacity than the projection in the theater, regardless of where such actions required for defense or attack.

It has ensured total domination of space combat, accurate and high intensity projection of air power, the development of fully integrated or independent action.

New theories and advanced models, both by the Allied Command Transformation and other structures engaged in the undertaking of transforming the military organization (Future Concepts and Transformation Division etc.) are designed to provide the necessary tools for the metamorphosis of the concepts and operational requirements in military capabilities which, once integrated to the force level, to determine the management of threats posed by opponents who rely on surprise, deception and asymmetric and unpredictable expression.

In the future threats context, an optimal balance should be determined in terms of impact, from traditional missions (surveillance and reconnaissance, air interdiction and close satellites and space-based radars, executing missions by air platforms possessing stealth technology or unmanned air vehicles, using smart munitions or actions of electronic air support, etc.) and the new kind favored by technological progress and application of new technologies (surveillance of air space through warfare, psychological, informational, deterrence, coercion and so on).

Considering population-centric operations, the Air Force will conduct a variety of missions, from the surveillance, prevention and interdiction, and continuing with the stability, protection, or post-conflict (protection of the civilian population segments, support for democratic and legitimate governments etc.).

The implications are many, and if "we start from the principle that the transformation is thought to be continuous, both concepts and operational design must be reevaluated together with the way of transposing them into practice."

BIBLIOGRAPHY

1. *** *Air Force Basic Doctrine, AFDD-1* (2003).
2. Barnett, Thomas, *Blueprint for Action: A Future Worth Creating*, Berkley Trade (2006)
2. Bohrer, David, *America's Special Forces, Weapons, Missions, Training*, MBI (1998).

3. Demchak, Chris, *Creating the Enemy: Global Diffusion of the Information Technology-Based Military Model* (2003).
4. Hammond, Grant, *Transformation – An Assessment in Crosscutting Issues in International Transformation*, The Center for Technology and National Security Policy, NDU, Washington, DC (2009).
5. Ivanov, Ivan Dinev, *Transforming NATO – New Allies, Missions and Capabilities*, Ed. Lexington Books, Plymouth, UK (2011).
6. Millett, Allan R., Murray, Wiliamson and Watman, Kenneth, *The Effectiveness of Military Organization*, in *International Security II*, no.1 (1986).
7. NATO, *Allied Command Transformation*, <http://www.act.nato.int/general-info/mis-sion>.
8. NATO, *Riga Summit Declaration*, <http://www.nato.int/docu/pr/2006/p06-150e.htm>
9. NATO, *Bucharest Summit Declaration*, 03.04.2008, Bucharest, Romania, http://www.nato.int/cps/en/natolive/official_texts_8443.htm#6.
10. Orzeată, Mihail, *Războiul Continuu*, Editura Militară, Bucuresti (2011)
11. Orzeată, Mihail, "Reforma în domeniul resursei umane (III). Educarea educatorilor", în "Gândirea Militară Românească" nr. 1 (2005).
12. Patry, Jean-Jacques, *L'ombre déchirée, la puissance aérienne contre la terreur*, L'Harmattan, Paris (2007).
13. Peck, Allen G., *Airpower's Crucial Role in Irregular Warfare*, în *Air & Space Power Journal*, <http://www.airpower.maxwell.af.mil/airchronicles/apj/apj07/sum07/peck.html> (2007).
14. Popa, Vasile, *Evoluția mediului de securitate, riscuri, amenințări și elemente actionale în dimensiunea aerospațială*, Ed. UNAP "Carol I", Bucuresti (2009).
15. Roxborough, Ian, *From Revolution to Transformation: the State of the Field*, în *Joint Force Quarterly*, Autumn (2002).
16. Thornton, Rod, *Asymmetrical Warfare: Threat and Response in the 21st Century*, Polity (2007).
17. USAF, *The US Air Force Transformation Flight Plan*, HQ USAF/XPXC Future Concepts and Transformation Division (2004)
18. US DoD, *Military Transformation – A Strategic Approach*, Washington, (2003).
19. US DoD, *Transformation Planning Guidance*, Washington (2003).