THE IMPACT OF SCIENCE AND TECHNOLOGY ON MILITARY STRATEGY

Vice-Admiral (ret.) Professor Engineer Ion Alexandru PLĂVICIOSU, PhD*
Colonel (ret.) Professor Engineer Eugen SITEANU, PhD*

In this article, some opinions regarding the interdependencies between military sciences (and also technologies) and the military strategy are briefly presented. There are credible arguments that the modern and reliable technologies have been a catalyst and a driving engine for the military phenomenon and military power, especially in the past 30 years. Military science and technology have grown dynamically over time and have required hard search in the direction of research and development both for the production of media combat performance, and to generate concepts, doctrines, strategies and tactics related to the use of the former in combat. Thus, new concepts, doctrines, strategies and tactics have appeared that improved the effectiveness of military actions that are using new combat means. Also, the changes in terms of concepts, management and organization of the armed combat have spurred the dynamic evolution of the military science. The latter, from its appearance, has been permanently established in a concrete support of military practice - from the optimization of the armed forces to providing them with highly effective equipment and weapons.

The impact of military sciences and technologies on military strategies may be illustrated very well by the evolution of the military actions of the major powers, based exclusively on the use of their capabilities and advantages.

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* Vice-Admiral (ret) Professor Engineer, PhD, Member of The Academy of Romanian Scientists; e-mail: alexplavion@yahoo.com

* Profesor univ. dr. ing., Academia Comercială, Satu Mare şi Universitatea Națională de Apărare „Carol I"; membru asociat al AOŞR; vicepreşedintele Asociației Absolvenților UNAp „Carol I"; e-mail: esiteanu@yahoo.com; tel.:0720566911.

Since prehistory, mankind has been preoccupied to increase their physical force by creating weapons that helped their fight against enemies, defense against predators, and facilitated hunting.

The development of human history is accompanied by the history of weapon development. As the human knowledge of nature became vaster, weapons became more complex and efficient too.

Throughout history, from the armament procurement and combat equipment points of view, the strategies used in various wars (local, regional, global) have been conditioned by the destructive potential on the enemy's forces and infrastructures. The consequences of using improved weapons were the increase of the destruction of infrastructure and of human casualties.

The necessity to acquire rapid and decisive success on the battlefield entailed the usage, especially in the military field, of the most recent scientific discoveries with military applications. As a result, the development of military technology was the promoter of the application of scientific knowledge. For instance, the multitude of local and regional conflicts during the Late Middle Ages led to a significant improvement of the combat means for that time.

The evolution of the military equipment during that time is characterized by its improvement (for instance, the cannon was qualitatively improved with regard to manufacturing metals and missiles); fundamental changes (such as the improvement of the harquebus, the appearance of the pistol, the improvement of fortifications); new achievements (the appearance of the warship with overlapped deck on which gun batteries were mounted), and the extinction of some combat means (spear, armor, sword, crossbow, arch).

In the 18th century, some inquisitive minds studied military science, and especially the manner in which the available means could be used more efficiently, in the same way Alexander the Great, Hannibal, or Caesar had done in Ancient Times.

It is worth mentioning here Chevalier du Teil, who published in 1778 the work: "About the Usage of New Artillery in the Campaign War," where he wrote about being offensive even in a defensive situation. He considered that Artillery had to focus its fire in order to create a decisive effect on one segment of the enemy line, and then Infantry to take advantage of this effect; this was a strategy of weapon combination.

At the end of this period, the pace of technical discoveries and their applications accelerated, and the transition from carriage to railway wagon, from sailing ship to steamer ship, from courier to telegraph was made.

After the French Revolution of 1789, many and important technical discoveries took place in science fields, and they constituted a significant increase in momentum to the development of society: the development of the chemical industry, metalworking, usage of the electrical battery, hydraulic cylinder, sea propeller, railway, electric telegraph, aircraft propeller, etc.

The period from 1861 to 1914 defines an age when industrial, technical, and scientific superiority constitutes a factor at least as important as numerical superiority and military genius of the commander. This is a time of military breakthrough as it was before the spreading of individual weapon technologies, and the cannon which used artificial mechanical energy for massive and fast transportation, both on land and sea; the instantaneous communication of information over great distances and in any weather conditions; the significant increase in the rate of fire, striking distance, and fire power of weapons of all calibers.

All military forces experienced, at the same time, new developments based on the scientific and technological progress in the various fields of human activity.

As a consequence of fast technical progress, one cannot ignore the type of armament used, the means of communication, and the capacity of the transportation means to transport rapidly and efficiently big loads of material and numerous troops.

Within this period (1861-1914), regulations for the services and branches are developed; in France in 1875, a new infantry regulation appears, but its basic doctrine does not agree with their national concept.

The German authors at that time are situated at a higher level than those of France. Clausewitz elevated the military thinking to a strategic level, and more precisely, to a politico-strategic level. He emphasized the idea that significant efforts, especially financial, economic, industrial, and human, are necessary to prepare for war. All German authors support the idea that modern war is not to be mistaken with chivalry conflicts of past times, but represents a way to acquire economic and political advantages.

Within the mentioned period, they insisted on the ideological aspect of the modern war which became a war of military equipment – quantity/numerical and quality/performance-based – which could not be replaced by the human sacrifices of the belligerents with insufficient industrial means.

Military equipment developed significantly during the First World War. New weapons appeared, such as automatic weapons, machine guns, artillery, aviation, ballistic rockets, acoustic searching torpedo heads, etc. They developed the mass production of complex machines and assemblies, designed usually for warfare. Also, new principles appeared with regard to the manufacturing and quality control of the goods delivered to the army.

During the Interbellum, J.F.C. Fuller published the following: "Tanks in the Big War" (1920) which constitutes a critical balance; "The Reformation of War" (1923) where he presents his concepts regarding the future of armored equipment and "Mechanized Warfare"; "The Foundations of the Science of War" in 1926; "On Future Warfare" (1929); "Regulations III" (1930).

Basil Liddell Hart wrote in 1923 "Tanks with Fuller and Other Non-Conformists - Hobbart, Martell, etc.", and de Gaulle published "France and its Army" (1938) and "The Army of the Future" (1934) in which he proposed the usage of armored tanks in massive formations; the creation of an army of maneuver and shock, mechanized and made up of elite personnel.

In Germany, Hans von Seckt published "Geuselegende Gedanken fur den Wiederaufban unsere Wertmacht" (1921), and Erwin Rommel "The Infantry Attacks" (1933); Heinz Wilhelm Guderian, a military theoretician, published in 1937 "Achtung! Panzer!".

In the Second World War, branded by the industrial power of the belligerents, the input of science in warfare can be noticed, associated with a quick transition from the fundamental or applied research stage to the operational usage (i.e., radar, ballistic rockets, and nuclear weapons).

The progress of human knowledge, of science and technology leads to the development of military technologies which become more and more sophisticated and efficient within the combat space.

As a consequence, wars became more and more violent, and the human and economic losses increased dramatically. The operational theaters were extended to a global level. Supporting the statement above, when comparing the statistical data related to the last two world wars, a substantial increase of military commitments and human losses can be noticed.

Thereby, our country's death toll was over 350,000 during the First World War and over 830,000 and missing in action during the Second World War.

The real causes that trigger wars are mainly economic in nature.

If the First World War was labeled by some analysts as being a family business, between the monarchies from Russia, Germany, and Austro-Hungary, its real causes were economic in nature, the necessity of a "vital space" have being invoked.

The major effects of the First World War were both economic and socio-political. Germany was forced to sign in 1919, under humiliating conditions, the Treaty of Versailles, to accept the responsibility for starting the war and to pay very large amounts of money in order to cover the war costs. Technology developed extensively after the war, especially the automotive industry, aircraft, radio communications, as well as the management of industrial activities.

The effects of the Second World War were felt at world level since the majority of the states were directly or indirectly involved in the conflict. The fight for national independence of the non-European countries was strongly stimulated by the war.

The weaknesses of France and England, two major imperialist powers, were opportunities for movements for national freedom; therefore, the European empires collapsed within approximately 3 decades after the war.

The military technology field made significant progress during the Second World War: the English invented the radar and the sonar which contributed to the progress in electronics and computers that later changed the world fundamentally. The manufacture of the nuclear bomb by European and American scientists during the war not only has changed the strategy, nature, and potential of the future wars, but also marked the beginning of the nuclear era.

The Russians suffered enormously during the war; western Russia was devastated. During the process of defeating Germany, the Russians built a wide array of powerful weapons and a strong army which occupied a large part of Eastern and Central European countries. The raw materials and material resources, as well as the size of the population helped Russia to become a superpower similar to the US.

The US economy was considerably stimulated by the Second World War, a lot more than by the First World War. The economic depression from 1929-1933 was finally surpassed and a new industrial complex was built in all American states, spared by war damage to infrastructures.

The US economy became the dominant economy of the world. After 4 years of military reconstruction, the US became a global military leader as well. Its position as a global military leader became more obvious than ever after the Second World War.

Military strategy is defined as being the warfare planning and managing actions; it is obvious that its main elements (i.e., set the objectives, prepare and concentrate the combat power, and maneuver) are conditioned by the extension and efficiency of combat actions, and the technical level of warfare means. If these means are superior in performance on the battle field to those belonging to the enemy, the strategic plans can be successfully applied in most of the cases.

Under these circumstances, the skilful usage of military technology for optimizing its effects is of major importance. The proper professional training of the soldiers is an essential condition to optimize the usage of the forces and decrease one's losses. Troop training has evolved in time; for instance, a warrior training in the Antiquity or the Middle Ages needed significantly less resources than the training of a modern military aircraft pilot, or the training of the information and communication system operator. This example shows the connection between technology and concrete actions to (technically) train the personnel, within the strategy.

Science in general and military science in particular contain an assembly of scientific domains which can ensure the development and application of the politics of military defense of a nation. Scientists, theoreticians, strategists, engineers, technicians, and prototype testing staff approach the majority of these domains. At the same time, military science affords the adjustment of military instruments to the security policy of a country. For this reason, military science researches the necessary armament to respond in an optimum manner to the problems it might be confronted with in a possible war. On the other hand, this science contains the military theories based on past wars in order to develop military strategies. Therefore, it is about optimizing the strike or response capabilities of the military forces in order to develop the best strategies and armament.

This concept includes all scientific fields involved in managing a military conflict: intelligence services, military equipment, conflict simulations, statistics, and logistics. It is undisputedly known that "theory does not have a practical result, nor does it provide 'recipes': it is made public through the doctrine". However, military science is the foundation of all components of military art (e.g. military art history, military geography, geostrategy, logistics, military technology, strategies, tactics, military action, etc.), and is found at all levels of military art, i.e., strategic, operational, and tactical.

Both military science and its components are interdisciplinary; we find in them not only the traditional sciences (mathematics, physics, chemistry, biophysics, engineering, etc.), but also the new sciences of micro systems, macro systems, and processes.

The objectives of military strategy must be strictly related to the armies' capabilities to carry them out, namely the level of procurement with higher performance armament and military technology, the level of training of the armed forces, as well as the capacity to organize and lead military campaigns. From this point of view it is possible to compare, for instance, the military actions carried out during the beginning of the Medieval Age, based on the direct confrontation of the fighters armed with swords, spears, bows, equipped with armor and helmets, to the military campaigns of modern times in which complex military means are engaged designed for total war, where there is a strong support for information, communication, optimization of the activities by using the information technologies, and in which the space technology is involved too.

At the same time, there is a strong concern to limit the exposure of the combatants on the battle field or to create adequate means of protection for situations in which their presence is necessary.

The impact of technologies on military strategies may be illustrated very well by the evolution of the military actions of the major powers, exclusively based on the use of their potential and advantages.

As a consequence of the economic development in the USA, the Woodrow Wilson doctrine founded during the First World War promoted the idea that the USA had the right and obligation to intervene on the European continent and anywhere else in order to defend freedom and to promote democracy.

Furthermore, the economic and military technology development in the USA is reflected in the evolution of the doctrine principles, as follows:

- The Truman doctrine was based on the idea of stopping the expansion of communism, and was supported and motivated by the nuclear hegemony of the USA.
- The Eisenhower doctrine (1957) says the USA will effectively use military force ('massive reprisals') against any aggression or imminence of aggression against it or its allied states, with the subsidiary idea to counteract the Russian influence in the Middle East.

In addition, it emphasizes the US intention to control the area of strategic oil resources. This objective is clearly expressed in the Carter doctrine (1980);

- The Kennedy doctrine has as core elements the mutually ensured destruction ('the balance of terror') and flexible response instead of massive reprisals. At the same time, its objective was to stop, by force included, the spread of the Soviet influence in Latin America;

- The Reagan doctrine proclaimed the unconditional support against communism anywhere in the world and launched the Strategic Defense Initiative program, also known as Star Wars.

With regard to the latter doctrine, it may be specified that its operational support relies on cutting edge technological and scientific elements and on high quality and reliability operational structures of extreme complexity. These include advanced surveillance systems of the areas of interest, including the outer space, monitoring the trajectories, and destroying the dangerous objects before they hit important targets on US territory. To back up this process, very briefly described, they use technical means made of global positioning systems; safe communication systems; hard and soft platforms designed to store, manage, evaluate, and utilize information regarding the potential forces and armament systems.

The accomplishment of such a program involves the consumption of important financial, material, and human resources, which is not obtainable for all states.

The Cold War period was characterized by mutual nuclear threats between the two military blocks, which confronted each other in order to divide the world into their zones of influence.

The potential of technology, especially the nuclear technology, played an important role in avoiding the Third World War, which would have destroyed the life on earth. During the "atomic peace" the world did not have peace: conflicts between the allies of the two blocks, civil wars, conflicts between the "second rate" nations (such as the war between Iran and Iraq), and decolonization wars. The antagonist blocks accumulated a large amount of military equipment, both conventional and nuclear. Science and technology made tremendous progress during this period. The world industry was completely changed. If in 1945 the most significant indicator of the economic power of a state was the steel production, now this indicator had lost its value; the economic power was given by the production of materials realized by high end technologies (electro-information, space, nuclear energy etc.). As a novelty, if for 45 years the "military peace" ruled in Europe, since the end of

communism the number of minor conflicts between the small states and that of civil wars to create new states has increased.

Nowadays, the knowledge in the military field has grown and develops rapidly under the auspices of a real revolution in the military domain (i.e., the Revolution in Military Affairs – RMA); almost all armies are undergoing this process: they are within an accelerated transformation process in order not to be left behind the progress of the society. RMA is part of the information technology revolution which sustains the specific problems of globalization. Globalization has helped the technology to develop rapidly, the commerce and financial investments to transcend the state's borders, and the revolution in the military field has been was accelerated by this phenomenon. RMA was not born in a "strategic void" because it amplified during post-Cold War period, as well as the military consequences of the industrial revolution coinciding with the boom of nationalism. As a consequence, in the contemporary military science the question rises if the "Future of the war consists in technology?" Due to the unprecedented improvements of technologies, the military analysts are already implementing upgrades in speed, capacity, and in general, precision of the weapons. The rapid improvement of the computers has increased the connection between the armed forces. The progress of technology has led, according to Michael O'Hanlon, to military robots for artillery, ground (VTV) and aerial (UAV) unmanned vehicles which foreshadow the future battlefield without many casualties. If technology will further develop, in any part of the world war could be waged within the national territory due to the guided ammunitions, air fighters and artillery which can be used without touching the ground.

But RMA technologically favors only the developed countries, especially the US. The military experts consider that the considerable technological differences will prevent the states with a lower development level than the US to take part in multinational operations, and these disparities caused by different technological capabilities will represent a source of tension between states.

War has remained a dramatic reality and a plague of humanity. Some entities began the wars by attacking, while others only defended themselves. The face of war has changed, but the part that has changed most is technology. Hence the idea that war will continue to exist as long as technology continues to evolve.

The technological revolution and RMA have not completely transformed the art of war, or military science, but have contributed to the development of new elements of strategy and tactics. The procedure, methods, and rules of military

tactics and strategy have been reevaluated and adjusted to the new phase, requirements, and possibilities of the combat means, and especially to the new types of risk, dangers, and threats to security. As a consequence, the military science of today should assume that in the near future, the military actions will probably take place in a fluid, multidimensional space, including the outer space, characterized by asymmetry, dispersability, decentralization, maneuverability, and flexibility.

The armies of the main developed states have professionalized and externalized some positions. These changes are reflected in the theoretical field where strategists, military analysts, scientists, and theoreticians elaborate doctrines, concepts, strategies for using the armies in preventing and managing the conflicts. Also, the war against international terrorism has triggered a concerted and extended research activity regarding the role of the army in this war.

It is obvious that military science and its technical application in this field have played and will play a significant role in the evolution of technical and technological progress of the entire society. There are two significant examples that illustrate this. First, the laser, discovered by military researchers, is now widely used by civilians. Second, the Internet, which initially appeared in the military field, has been adopted by civil society, and now all people take advantage of it, no matter their profession. Unfortunately, man uses each scientific and technological progress to improve his "panoply" of war, because he fears that his adversary will outrun him, and also because he is convinced that his cause is just. The explanation is obvious: the collective and individual defense and security needs, the necessity to ensure the material resources for each person and for the community has always involved continuous research and development of performing combat means and generated the concepts, doctrines, strategies, and tactics for using the means in combat.

As a consequence, the invention of a new weapon by the "potential enemy" generated the necessity of an "antidote". For instance, the emergence of the military aviation led to the creation of new efficient combat means of air defense artillery. Also, new concepts, doctrines, strategies, and tactics have appeared in order to increase the efficiency of the military actions using the new combat means. At the same time, the modification of the concepts, management, and organization of the armed combat have promoted the dynamic evolution of the military science. Since its coming into being, the military science has permanently been a substantial

support for military practice – from the improvement of the forced army organization to their equipping with highly efficient armament and weapon systems.

It has been proven that military science is linked to the evolution of combat weapons, and its development has caused the rapid development of military practice. The technical and technological progress of military weapons and military science are mutually influenced and permanently supporting each other. The discovery of more performing weapons is due to the military science development and represents the starting point for new research fields aiming at their efficient implementation in the multidimensional combat space.

The universality of military science is a reality expressed by the products of military practice and theory, in time and space, during the existence and development of the human society.

Even states with lower economic power are able to and have to take part in the improvement of military technology, to correlate their strategic objectives to it and to the tasks regarding their contribution to global or regional security, within the military alliances.

Special attention is given to the technology transfer from civil and military applications, in order to decrease the cost of the equipment.

There are possibilities of development for the small states which must constitute objectives of technical infrastructure of strategy and national military doctrine, as follows:

- Development and implementation of aerial surveillance systems for the national territory and of the fleet-management information systems;
- Increase of the fire power and accuracy, of the firing distance and effect on the target, round the clock and under any weather conditions, of the classic armament;
- Computerization of the command units through the implementation of C4I2 systems from battalions to the large fighting units, the realization of the information flow and management inside and among military forces;
- The development of the means which ensure fast maneuverability and deployment of military forces and their equipment within the national territory or in the theatre of operations;
- The development of the potential to ensure the logistic support for the technical equipment;

- The realization of short and very short range weapon systems which would ensure low height air defense of the air force and navy units, troop concentrations, and major military and economic assets.

The emergence and maintaining of conflicts which involves locally two nations, generated by economic, religious, territorial claims issues, or issues of any other nature, are not indifferent to the technology progress.

The local armed conflicts, with their specific strategies, can break out between nations belonging to the same military alliance (e.g. Turkey versus Greece in Cyprus), or between the promoters of the "democracy" imposed by force to less developed nations, for economic reasons, or for gaining influence in certain areas.

It is worth emphasizing that in this particular case a major component of victory is given by the soldiers' morale; they cannot be defeated by forces better trained and equipped. There are numerous examples in this regard: Afghanistan could not be "democratized" either by the English, or by the Russians, and now the Americans are still having problems in this part of the world.

Although the American war machine is without precedent, regarding its equipment and combat capacity, it has not achieved notable success either in Vietnam, Korea, Sudan, or Somalia, and the prospect of a successful end of its military actions in Iraq and Afghanistan is still uncertain.

Classic means are used to a certain extent in these "local conflicts": armored vehicles, field artillery in fixed position and self-propelled artillery, fighters and bombers, short and medium range surface-to-surface missiles, equipment which was developed in order to decrease the vulnerability of the crew and to increase the destruction capacity.

Their modern versions benefit from electronic components which increase, to the highest levels, the orientation possibilities in the tactical field (through coupling military systems to the GPS and the possibility to use very accurate digital maps); the capacity to identify and classify enemy targets by using sensors in the visible spectrum, radar, infrared, or night vision equipment; the effect on the target of the armament by using electronic targeting systems which increases the accuracy of firing and highly reduces the reaction time. The increase of the ammunition destruction capacity by using high power explosives, binary explosives, shaped charges or tactical nuclear weapons adds up to those mentioned above.

This is the first aspect related to the strategy and the tactics of the use of the means specified above, in the tactical field, which is also decisive for the fighting

units' safety. Before starting the fight, the combat units receive accurate information regarding the enemy, collected by direct observation made by specialized satellites or by UAV, TAV researching means, or specially equipped helicopters.

By using electronic simulation, the cutting-edge military technologies afford better organization and planning of the military actions, the estimation of the necessary means and preliminary estimates of losses.

The recent military conflicts distinguished new concepts regarding the training and execution of the combat actions, dynamic and mobile, using professional fighters and cutting-edge military technology.

In military actions, space becomes more and more integrated, including land, air, naval, outer space completely digitized components due to the extension of the capacity to use information and to command the troops.

The development of the military technology required the subsequent development of the military logistics and a change of the concept in order to include the appropriate ensurance of all tactical field factors' necessities. Logistics is, in essence, the planning process for military forces for the military operation purposes. It includes design, development, acquisition, storage, transport, supply, distribution, and evacuation of personnel facilities; installation; and maintenance services.

Global logistics permanently impose a quality level which requires the logistics to undergo a permanent renewing process, in accordance with new technological acquisitions, regarding equipment, training and support. From this perspective, the logistics foundation is very important for dimensioning the military forces, starting from the fact that any operational sub-unit becomes functional through adequate logistic support, designed in the depth of echelons of tactical, operational, and strategic levels.

The Romanian experience in this field provides uncalled for examples when armament, equipment, and military technology have been procured without getting the appropriate solutions to ensure the ammunition, spare parts, maintenance materials, equipment and tools for operating them and training the personnel, maintenance operations have been ignored, all this having a negative effect on availability on the battlefield. The logistic systems of technologically advanced armies widely use information technology which ensures the timely supply and in the necessary locations (which can sometimes be within considerable geographical distance) of the food for troops, fuel, ammunition, spare parts, etc.

Information technology has fundamentally changed the classic procedure for the logistic supply for troops, so that they became fast, flexible, efficient, and controllable.

In the modern armies, the models of organization and procurement of the combat units, based on new, innovative technologies, have led to the decrease of losses, especially human lives. Even though the US commitment increased in the Second World War in comparison with the First World War, the loss of human lives did not increase at the same pace.

The accomplishment of strategic systems at global level like "the Star Wars"-type or the global coverage by positioning systems, or global communications require huge funds which are unaffordable even for the developed countries.

This is one more aspect that has changed the strategic concepts in the way in which the investments in these technologies can be done by attracting the support of more nations interested in security strategies.

Their contribution can be only financial, or they (the developed countries) can participate in solving some of the sections of the strategic programs. At European level, there are examples in the field of military aircraft, multi-role, helicopters, long range rockets, global positioning systems, and armored vehicles, specialized information systems for command, control, and management.

At the same time, each nation should identify and pursue its own interests and be concerned about participating as much as possible in research, development, and production of military technology even when it belongs to a political-military organization.

Taking into consideration the high costs of military equipment – not only for procurement, but also for training, operating, maintenance, replacement – it is advantageous that the tasks related to the contribution for security within the alliance be also supported by military equipment produced in-country.

The participation of the small and middle-sized states in providing the alliance with armament, ammunition, and military technology is meant, by its nature, to ease the effort to equip the own troops at the alliance standards and to avoid the import of unemployment. They also commit themselves to invest in research and development of new military technology with a positive impact on the nation-scale technological level, because it is well-known that the military technologies are the drivers of progress.

In Romania, as a consequence of the massive investments in the defense industry, which was gradually created since the end of '70s and the beginning of '80s, a powerful infrastructure for research, development and production grew to approximately 35 large factories with a total of over 140,000 employees.

In a natural way, the scientific research in the field, supported by approximately 8,000 researchers, technological engineers, and designers, was subjected to the operational requirements of the defense industry, its task being to elaborate new categories of military technology with the highest possible degree of domestic integration. Based on this, to the end of '80s, a great part of the imports for completion and important categories of military technologies was eliminated.

The defense industry achievements before 1989 have afforded the army procurement, so that in the second part of '80s over 85% of the necessary equipment was produced in-country and also some was made available for export. They would still import equipment for fighter aircraft, navigation equipment for aircraft, automatic naval cannons with firing units, radar stations for air- defense, and part of the underwater weapons necessary for the Navy.

The Romanian Army, as party to the Warsaw Pact at that time, was equipped with military technology of Soviet inspiration with the exception of aerospace and nuclear technology and had important shortcomings in comparison with the similar Western technology, shortcomings generated by the "philosophy" of its design and execution. At that time, Western technologies embodied high performance and subtle elements of microelectronics, sensors and microprocessors, optical devices and so on, while the technology available for the states under the Soviet influence was rudimentary by comparison, with a lot of electro-mechanic components and, initially, with electronics with vacuum tubes. The above mentioned shortcomings materialized in products with the same level of performance, but oversized and heavy, uneconomical in point of energy and operation, with complicated and difficult operating instructions for their operators (especially because of the lack of use of the process optimizing technologies using information technology) and the protection degree of the operators during operation was low.

The production technologies used were also big consumers of raw materials, materials and energy, and usually the issue of specific consumption on the produced unit was superficially approached.

Further to the reorganization of the army and the other forces that ensure the national security, and the drastic decrease of the exports to the traditional

markets, after 1989, the demand for military technology and equipment, armament and ammunition gradually decreased every year. This led to a major rebound of this sector of the national industry.

As a consequence, the production capacities were resized in relation with the demands of the national defense system and foreign partners. In order to eliminate parallelisms and supra-production, the production facilities were regrouped, the military ones were separated from the civil ones – where possible – and some of them were upgraded by investments.

The defense industry must continue to be a field of strategic interest for Romania.

Maintaining a powerful sector of the defense industry, organized on the principles of the market economy, can be able to meet simultaneously the domestic needs of technologies, special equipment, armament and ammunition. The specialized producers can participate into the realization of a significant part of the interoperability objectives agreed upon with NATO, and can also produce for export.

The integration in NATO and EU structures and the adherence to the European Agency for Armament does not impose the elimination of the defense industry, but on the contrary, its material and financial support.

Not all states afford to proceed, within a reasonable period of time, to the information society and realization of operational structures and logistic infrastructures specific to modern war, but some efforts in this direction must be made. Even if the costs of training and instruction of the military personnel are bearable, the compatibilization of the technical means, armament, and ammunition with those specific to NATO involves big and expensive efforts, and this should be made by political decision, during a longer period of time, based on a definite and well designed program.

The political decision makers must clearly define the system of probable risks and threats which Romania might need to counteract and, based on it, to set the national military structure, the character and nature of the military actions that should be conducted in case of an aggression, the configuration of the mobilization system and of preparation for defense of the economy and territory, the system for politico-military decision and for commanding the war actions.

The decisions adopted must be tailored to the requirements and challenges of the modern war, and gradually incorporate the compatibility and interoperability standards of allied armies within the Euro-Atlantic area.

Moreover, different approaches with regard to the organizational structure and specific procurement have appeared because of the asymmetric threats, organized crime development, cross-border criminality, and the increase of the gravity of the internal threats to the national security.

There still are reasons for local conflicts to break out in the future, strictly limited territorially, when the disputes cannot be diplomatically settled. The development of these conflicts in time is, as a rule, limited by the international reactions that impose the belligerents to show partiality towards the diplomatic means instead of war.

The foreseen characteristic of the future local conflicts is demassification, i.e., the decrease of the critical mass engaged in the military action; the military forces are reduced, the armament is optimized, quantity is compensated by quality, maintenance costs are reduced. Smaller but more powerful and easy to maneuver operational structures are set up. The transition from traditional to non-lethal weapons, the control of information, of material and energy (both visible and invisible) media become more obvious.

The probability for a conflict at global level to commence is low, based on the information related to the reasons underlying such a conflict.

First of all, the development of the technologies is not any more the privilege of just one power. The circulation of information, easy access to the new technologies, human and financial investments in military research have led to the emergence and development of new centers of power with large economic and demographic resources which increase the multi-polarity phenomenon: China, India, Japan, and Brazil. The expansion of the "atomic club" by countries like India, China, Pakistan, Israel, and the development in these countries of the means of transportation and space technologies balance significantly the potential of armed conflicts at global level.

The freedom of circulation allowed by the creation of powerful communities of Chinese, Indians, Pakistani, or Africans in Western states (especially France) which represent a source of technological, financial, and information transfer to the country of origins, contributed to their development.

The public opinion is better and more concretely informed about the areas of tension and the possible beginning of conflicts due to the socialization nets with millions of members developed on the Internet and is therefore harder to manipulate.

The civil society is better informed, it has an increasing role in standing against war; it can force the politicians and governs to choose different ways to resolve and settle the conflicts escalating into war.

There are many examples in modern history when the military conflicts were ended further to the protests of the civil society and the non-governmental organizations.

The development of military technologies, the increase of the destructive potential of the armament, the emergence of new types of threats paradoxically is a reason to deter military aggressions.

According to the new risks and threats, and to the "strategic concept" adopted by NATO state and government leaders at Rome in 1991, the danger of a war in Europe has virtually disappeared, but there are still risks and uncertainty for the members of the Alliance and for the other states from the Euro-Atlantic region.

These regard the ethnic conflicts, violation of human rights, political instability, precarious economy, spread of nuclear, biological and chemical weapons and spread of the means to supply them.

Taking into consideration the destructive effect of the military technology at global level, not only on humans and infrastructure but also on the environment, the question is if and under what circumstances a new conflict of the amplitude of the last two world conflagrations may take place.

In our times, the war waged by classical means which targets at the destruction of the enemy manpower and infrastructure of is less likely. The development of the technologies, especially in the information field, has led to a different type of threats: against information systems for financial management, population records, banking systems, management of the energy systems of transportation and of communication might have a more devastating economic effect than a war, and can be launched from various locations, including the territory of the attack.

One characteristic of the present society is the existence of dynamic structures with rapid transformations with constant character, for which the necessary time for making decisions has been enormously compressed, the succession turning into simultaneity. In this context, it is normal and desirable to have a large technology transfer from the areas in which, by massive investments specific to defense, nuclear, and aerospace technologies, important achievements have been obtained, and the boundaries of knowledge have been exceeded.

Within this approach, the concept of dual or dual use technologies has been imposed, which actually represents the transfer of knowledge and applications from exclusive fields previously specified in civil fields, in order to improve the natural environment of man, to preserve it, to create conditions for the effective release of humanity from physical or intellectual constraints imposed by the man-nature relationship.

The great challenges that mankind has to face are the consequences of phenomena like natural, material and energy resource exhaustion, uncontrolled environmental pollution, population growth, with consequences on the ability to provide an adequate food supply.

Of real interest in this context, because of its amplitude and consequences, is the monitoring and management of some processes, at regional and global scale, with major influences upon the environmental unbalance, using satellite technologies, information technologies, and the amazing development of the communication capacity.

Contemporary technology cannot provide the necessary conditions for sustainable development if it destroys the society assets that the eco-sphere depends on, and at the same time demands permanent consideration for its advantages to be balanced by its ecological value.

This is about that mild technology specific to the mentioned fields, characterized by:

- Risk-free applications for human health and survival;
- Continuous renewal of the products from the constructive, functional and qualitative point of view;
- Preeminent utilization of the natural substances;
- Reduction of consumption of raw materials, materials, and energy.

Technology transfer for the benefit of the civil society can be activated by increasing the technology diffusing ratio, increasing technological substitution ratio, the frequency of applied technological innovations and decrease of the temporal disparity between the innovation emergence and its application.

Technology transfer leads to the elimination or decrease of undesired effects related to the transition from general theory to applications, the elimination of the degree of uncertainty in scientific research, decrease of technology development costs, elimination by political action and intervention of specialized authorities, of objectionable aspects of the application of the laws of physics, etc.

The conclusion of the analysis of the interdependencies between technology and strategy is that within this binomial the technological factor is the most mobile. The fast development of the armament, ammunition of any kind, and combat technology by using the latest results of scientific research has facilitated the increase of the possibilities to select targets, the accuracy of their destruction, the limitless increase of the firing distance, the possibility to use the extra atmospheric space, and to control the collateral effects and damage as much as possible.

In this context, the permanent adjustment of the strategic concepts becomes a mandatory necessity for the commanders which are empowered to make decisions at this level; they must be properly trained regarding the combat technical capabilities.

There are situations when the development of new "in vitro" strategic concepts by military powerful states, in order to apply new doctrines with global coverage, requires from the scientific community to develop weapon systems able to meet the development of new doctrines. A permanent collaboration between the army structures and the scientific community is required and for this purpose a specialized organism should be developed within the defense systems.