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INTRODUCTION

I am delighted to introduce the inaugural issue of *Security and Defence Quarterly* – a new scientific journal, which opens another series of the National Defence University publications.

Security and Defence Quarterly was formed on the initiative of the National Defence University in Poland, so as to create opportunities to intensify the exchange of scientific ideas between the universities affiliated to the Central European Forum on Military Education (CEFME). The Scientific Committee of the magazine consists of the Heads of the partner universities. It is the committee's intention to focus on the defence and security issues of Central Europe, both from the perspective of particular countries in the region, as well as the European and international perspectives.

Although *Security and Defence Quarterly* is dedicated predominantly to the scientists who represent CEFME universities, the journal publishes scientific articles whose contents can be of interest to a wide range of scientists, scholars, researchers and policy makers; thus, to develop and enhance the flow of information between both academic and non-academic institutions, we also encourage the publication of scientific articles by specialists from other countries and institutions on the issues of security and defence on a state, regional and global scale. Therefore, I would like to welcome local and international researchers and universities to contribute to the future publications of this journal.

I would also like to thank everybody who took an active part in the creation process of the project - all the contributors for their articles in this inaugural volume, as well as the editors for their dedication to making the first issue of *Security and Defence Quarterly* a success.

Hoping that the ideas shared in the journal will contribute to the raising awareness of security and defence as well as to promoting peace and stability, I wish you a pleasant read.

Rector-Commandant
National Defence University
Warsaw, Poland
Maj. Gen. Bogusław PACEK, Assoc. Prof

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INTERNATIONAL SECURITY

THEORETICAL AND METHODOLOGICAL VIEWS OF DEFINITION OF CONFLICTS

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Abstract

Of all the other terms, conflict is a basic concept that appears most frequently in this article. The term has a Latin origin and is derived from the word of conflictus. It covers a range of meanings, including a fight, collision, clash, dispute, rift, misunderstanding, contradiction, or a tendency to run into each other or collide with each other. In essence, it is an activity, undertaken by individuals or groups, aimed or directed against another individual or group owing to inconsistencies in their needs, differences in their interests, and tendencies of discord in their relationships, whether for political, religious, ethnic, racial or any other reasons. The concept of conflict has accompanied the existence of mankind and society from its inception and has been observable in the entire course of human history.

Key words*:* Conflict, security, research, definition, classification.

Introduction

The profound changes unfolding in the world after the end of the Cold War in the late 1980s have since then been accompanied, mainly under the influence of globalization in the early 21st century, by an unprecedented acceleration in the development of human society. Unlike in the past, today's profound qualitative changes in all walks of life manifest themselves already over the lifetime of a single

generation. With the increasing dynamics of the economic, social, scientific, technical and technological development, the potential for changes is so great that not only every nation state but also the entire international community must now pay continuous attention to analysing such developmental tendencies, and this is particularly true in the sphere of national and international security.

Unfortunately, the fundamental changes in the global security environment, emerging after the fall of bipolarity, have brought, besides their uncontested positives, also numerous negatives. While the positive side of this process has become manifested mainly in and through the removal of the threat of war between two antagonistic military-political groupings – the North Atlantic Treaty Organization and the Warsaw Pact, as well as the threat of a possible nuclear missile apocalypse, the negative side has increasingly manifested itself through diverse forms of terrorism, asymmetric security threats and an increased prevalence of crises and conflicts throughout the world. The tremendous changes in the global security environment, combined with massive transformations in the political, economic, social, environmental and technological fields, have provoked in the world not only integrating but also disintegrating tendencies and efforts, spearheaded by a number of countries and groups.

Despite this, a classic conventional conflict between two states has become extremely rare in recent years. After the end of the Cold War and the fall of the Iron Curtain, war has turned out to be an outdated phenomenon especially in the Euro-Atlantic region. Besides political, economic, social and other factors, one of the main drivers behind this is the fact that the new line-up of sophisticated weapons, weapon systems and military technologies is so overwhelmingly powerful and destructive that the weapons are rendered almost impossible to use in warfare. This mostly relates to weapons of mass destruction and conventional high precision weapons of enormous destructive power, the use of which by the belligerent parties would result in far-reaching consequences. Indeed, this is one reason why such military tools are no longer exploited in pursuit of national interests and as solutions to potential conflicts.

Nevertheless, conflicts continue to be waged outside the Euro-Atlantic area, whereas most of them have taken place or are still taking place in a region referred to by Francis Fukuyama as "historical." This is a region where the fundamental questions pertaining to the existence and functioning of individual countries have

not been resolved yet, and where the willingness to "wield swords" and to sacrifice human lives in pursuit of one's goals still prevails. Therefore, the primary goal of the authors of the article, grounded on publicly accessible information, data and facts whilst using standard methods of scientific research, is to provide readers with a view of the definition of conflicts.

Research on Conflicts

The initial research in the field of conflicts was mainly geared towards the inter-relations between peace and war and the rifts and contradictions of class struggle, etc. Today research done on conflicts combines the research results of peace and war studies with international relations, political science, sociology, economics, defence and security, and international law. Each of these disciplines approaches the field of conflicts from its specific theoretical insight and, therefore, there exist numerous different definitions of conflict as well as methods of analysis. While some analyses deal more with the military aspects of conflict, and some with political and economic ones, others are more concerned with the sociological and geographical aspects.

In their research studies and publications, individual researchers and authors also deal with different facets of conflicts and treat them from different angles, placing emphasis on a variety of conflict-related factors and elements. Despite this, it may be generally stated that conflict is conceived as a phenomenon composed of mutually interconnected elements – actors, issues, dynamics and contexts. It follows from the above that the definition and categorization of conflict is a very demanding and complex process. To delineate the empirical field of research, it is necessary to establish criteria for defining conflict, so that we can distinguish which phenomenon should be included or excluded. This must also be done to ensure consistency in the use of terms.

The definition of conflict should be wide enough to not only apply to a particular historical period or type of conflict but also to include all conflicts. At the same time, it should be accurate for the purpose of data collection and the possibility of delineating a specific conflict in time and space by different researchers. In examining conflicts, it is imperative to adopt an impartial approach towards

the actual definition of conflict. Wasmuth summarizes four conditions for an impartial investigation of conflicts, as follows:

a) conflict should be viewed as a social fact and should not be confused with its form,
b) the definition of conflict should not contain any limiting assessment so as not to pre-determine the conflict's analysis,
c) in defining conflict, it is essential to avoid unnecessarily narrowing down the definition by contextual characteristics, so as not to reduce the complexity of the entire concept,
d) the definition of conflict should not confuse cause with effect.

Definitions of Conflicts

According to Wallensteen, conflict is more than a particular conduct or action and, therefore, must contain a certain element of incompatibility, i.e. serious disagreement between a minimum of two parties whose needs cannot be met at the same time. The incompatibility of their positions lies in the lack of limited resources. Hence, it is a condition in which adversaries perceive conflict as a zero-sum game. The basic elements of conflict entail actors, activity, and incompatibility of interests. These determine Wallensteen's definition of conflict as being a "social situation in which a minimum of two parties strive to acquire at the same moment in time an available set of scarce resources", whereby the parties' efforts encompass a wide range of actions from making threats to waging war. Resources are not conceived as mere economic wealth but rather all that which an actor is interested in, for instance, justice, observance of moral principles, wielding of political power, territorial control, etc.

A similar definition was formulated by Bartos and Wehr, who define conflict as a situation in which "actors use conflict behaviour against each other to attain incompatible goals and/or to express their hostility". Their military analysis is more concentrated on analysing the incompatibility of objectives, development of conflict behaviour and hostility as the underlying causes of conflict. The supplied definitions of conflict are seen from different perspectives and emphasise different elements. Nevertheless, each of them is based on the existence of at least two

actors, among whom there is a certain incompatibility of interests and who are actively committed to actions furthering their goals.

According to Weber, society is made up of groups that differentiate themselves from others in their status. Given the different status, they also have different interests that cause conflicts. Consequently, any hope of eliminating conflicts from human society with regard to the existence of different status groups is illusionary and, therefore, we need to become reconciled with the eternal struggle of one group fighting against another. In this context, however, it should be noted that the interests of groups and individuals are not only contradictory but also identical, insofar as they serve as a basis for attainment of balance and consensus.

Simmel bases his examination of conflicts on the postulate that egoistic groups that exist in society are not isolated from each other; on the contrary, they are interwoven by a myriad of invisible threads. In his opinion, it is the pursuance of group interests that mitigates conflicts and fosters the common grounds that can ensure societal stability. Despite this, conflicts are inseparably interwoven into the fabric of everyday life of society.

The ideas of Simmel were further developed by Coser, who, in his work, focused on the analysis of the conflict's positive functions. According to him, conflict may contribute to either sustainability or adaptation of existing social relations or structures. It is right in Coser's work that we observe one of the central themes of conflict theory, whereby socially dangerous are not the conflicts themselves but rather the absence of rules to contain them. The presence of conflicts is a natural state of society. Not the presence but the absence of conflicts in society was, in his opinion, an abnormal phenomenon. Coser asserts that conflict is a struggle over values or claims to specific status, or struggle over power and resources in which the aims of the opponents are to neutralize, injure, or eliminate one's rivals. He maintains that the essence of conflict consists in the clash of values and interests of different social groups.

Waissová defines conflict as a social reality, where two parties stand against each other (individuals, groups or states) with a different view of a particular fact or with divergent (opposing) interests. According to Krejčí, conflict represents a situation, whereby a specific group (tribe, ethnicity, political party, a coalition of parties, an alliance of states) or an individual is in deliberate conflict with one

or more groups or individuals. According to him, conflict is a struggle over values pertaining to status or an attempt to preserve or enhance one's power, in which the aims of the parties to the conflict are to neutralize, injure or eliminate their opponents.

The theory of conflict is also elaborated on by Dahrendorf, who focuses on clarifying the sources of conflict. He claims that the principal source of conflict is not a clash of economic nature but rather the political rivalry among social groups in an attempt to gain a share of power and the chance to make decisions about those who have been excluded from sharing power.

For international relations, a conflict that enfolds in the sphere of politics becomes the centre of attention – a political conflict, which is, according to Pfetsch and Rohloff, conceived as a clash of overlapping interests, built around national values and themes (such as independence, right to self-determination, border and territory, distribution of domestic and international power, access to power, etc.). It must last for a certain period of time, have a specific extent, and involve at least two parties (states, groups of states, organized groups or organizations) determined to further their own interests and achieve victory, whereas one of the parties must be an organized state. Tools possibly employed in the course of conflict resolution entail negotiation, threat, pressure, passive and active termination of conflict, use of physical force and war. In spite of the fact that it is a relatively complex definition of conflict, it fails to include conflicts enfolding in the political sphere, for example, conflicts between two non-state actors, nor does it take account of economic interests such as motivation for instigating a conflict.

A broader definition of conflict is offered by the Heidelberger Institut für Internationale Konfliktforschung. It views political conflict as a clash of interests (different positions) in relation to national values. Such conflict has a particular time interval and seriousness (extent), and involves at least two parties (organized groups, states, groups of states, organizations) determined to pursue their intentions and achieve their goals. Political conflicts may assume violent or non-violent forms. According to the Peace Research Institute Oslo, the criterion being applied in this case presupposes the use of armed violence, aimed at furthering the actor's position in the conflict, with an inevitable consequence of the emergence of victims. The Uppsala Conflict Data Program views an armed conflict as an

incompatibility related to a government/territory, while the use of armed force between two actors, of which at least one is a government actor, results in a *25* battle-related death threshold.

The most extreme form of armed conflict is war. To avoid any confusion between these concepts, it is necessary to determine the difference between "armed conflict" and "war", because every war is an armed conflict but not every conflict will result in war. In this case, Vasquez adopts Bull's definition. Accordingly, "war represents organized violence carried out by political units against each other" just because it may be simple yet broad enough to encompass different types of actors and the subject of the conflict, whilst at the same time including an element of organized violence, not a random activity, but rather a premeditated and collective action.

Conclusions

For the purpose of accomplishing the objectives of this article, conflict is conceived as a situation in which at least one party systematically uses armed violence, with the aim of furthering its political and/or other interests. This definition incorporates the aspect of systematicity, i.e. organized, purposeful and continuous use of armed force, which distinguishes armed conflict from organized crime, or coincidental pathological phenomena. At the same time, it includes an element of violence in achieving one's goals.

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SEEKING PEACE AND DEVELOPMENT: CHINA GOES HAND IN HAND WITH THE WORLD

Xu Jian
Ambassador of the Republic of China

I was asked by Mr. Rector NDU Warsaw to talk about China's perspective on contemporary security challenges. It is certain that different countries have different understanding on that issue. Here I am going to share some of my views.

"Peace and development are the two themes of the world". That was a statement in 1985 by Mr. Deng Xiaoping, chief architect of China's opening up and reform as well as the modernization drive. Even though the world is undergoing profound and complex changes, the theme of the times remain unchanged, i.e. peace and development.

Today the trend towards a multi-polar world and economic globalization has gathered momentum. There has been greater cultural diversity and an information society is fast emerging. New breakthroughs are in the making in the scientific and technological revolution. Global cooperation is expanding at multiple levels and on all fronts. Emerging market economies and developing countries are gaining in overall strength, balancing the international forces in favor of the maintenance of world peace. We are pleased to see that more favorable conditions for the maintenance of overall stability in the world are on the increase.

Yet at the same time, the world is still far from being peaceful and is facing many challenges.

We still face a tough situation regarding traditional security challenges. Disputes over territories, ethnic strife and religion have led to numerous regional conflicts. Some hot-spot issues are still unsolved. In countries like Iraq, Afghanistan, and others, there are civilian losses almost everyday. Palestine-Israel peace talks still have a long way to go. The situation in West Asia and North Africa is still volatile.

As for non-traditional security challenges, economic crisis, natural disasters, climate change, cyber security, energy security, and some others are also on the rise. The European debt crisis led to the rising unemployment rate, intensified social conflicts and the weary recovery of the economy. In 2012, a total economic loss of US$160 billion and a loss of more than 10,000 human lives in the world were caused by natural disasters like earthquakes, floods, hurricanes, etc. More incidents of cyber security were reported on the front pages of newspapers and hacker attacks are increased. Numerous greenhouse gas emission leads to global warming and some low-lying coastal areas or island countries are facing the danger of being submerged. Phenomenon like terrorism, weapon proliferation, spread of diseases, transnational crimes, drug smuggling, and illegal immigration are increasingly affecting the world peace and stability.

For the causes of the above-mentioned critical problems, the reasons are as follows.

Firstly, it is because of the old international political and economic order, which is unequal, unfair and unreasonable. Since modern times, the oppression and exploitation of developing countries by imperialism and colonialism have left behind many historical issues, which caused some regional conflicts long unsolved and provided a breeding ground for terrorism.

Secondly, it is because of the outdated cold war mentality. Regardless of other countries' security needs, some countries only focus in pursuing their own maximized interests, imagining threats and provoking confrontation.

And thirdly, it is because of the economic development model built at the price of environment. In the economic development, the short-term interest overrode the long-term interests of mankind. Human development is thus greatly endangered by the severe environmental problems such as serious air pollution, water crisis, forest damage, less biodiversity, global warming, and so on.

As globalization deepens, countries are interdependent with their interests more closely entwined than ever before. Global challenges become the main threats, and common security issues get more prominent. We are living in a world that all countries are interconnected in times of both peace and danger. No single country can face all the challenges alone. We have to join our efforts in pursuing a peaceful route of development for the whole mankind.

To achieve peaceful development, it is a prerequisite that we build up equality and mutual trust as the first thing. Countries, big or small, strong or weak, rich or poor, are all equal members of the international community. Only by treating each other equally and enhance mutual trust steadily can we overcome differences, resolve the contradiction and estrangement, achieve mutual understanding and live together peacefully and amiably among nations and peoples. Only by doing so, a more solid basis for world peace and stability can be secured.

Take the China-US relation as an example. Being the largest developing country and the largest developed one respectively, China and the United States have different social systems. But since its founding, China has been advocating the five principles of peaceful coexistence with equality and mutual trust as the core. We have been all the time seeking the deepening of the mutual trust based on mutual respect in handling the bilateral relation with the US, which is developing steadily from confrontation to dialogue and cooperation. We then reached consensus on co-building a new type of relationship between major countries that features mutual respect and mutual benefit. At this point, I would like to mention the contribution of Poland. Between 1958 and 1970, China and the United States, without diplomatic relations then, held dozens of ambassadorial talks in Lazienki Park. The talks served as the chief means of communication between China and US at that time and played an important role in building mutual trust between the two countries. Last year, the unveiling ceremony for a plaque commemorating the historic China-US talks at Myslewicki Palace was held in Lazienki Park and his Excellency Mr.Komorowski, President of Poland, attended the event. The Myslewicki Palace thus became the symbol and embodiment of friendship among China, US and Poland.

Another example is the China-Russia relation. Being the largest neighboring countries, China and Russia had gone through twists and turns in the bilateral ties. Thanks to joint efforts from both countries, a comprehensive strategic

partnership of cooperation between China and Russia has now been established. With the features of equality and trust, mutual support, common prosperity and friendship from generations to generations, the relationship is non-aligned, non-confrontational, and is not targeted at any third country. Besides, in the last decade or so the two countries have been working together in the global security affairs and making joint efforts to seek for a peaceful development in advocating the new security concept of mutual trust, mutual benefit, equality and cooperation.

Last month I paid a visit to Auschwitz concentration camp, the biggest Nazi concentration camp during World War II, and the biggest killing center of Jews in Europe. The misfortune of Auschwitz is that of all human beings. It constantly reminds us that goodwill of mutual trust can be understood only by having the attitude of equality towards a person, the other peoples or a country. Otherwise we will fall to the abyss of hatred and massacre.

On the basis of equality and mutual trust, we have to make sure to promote inclusiveness and mutual learning. In other words, we have to show respect to the diversity of civilizations and development paths, to show respect to and safeguard the rights of all peoples for their own choice of their social system and development path, to complement one another for the advancement of human civilization.

All rivers run into sea, a great tolerance. In today's world, there are more than 200 countries and regions with a total population of 6 billion in 2500 ethnic groups, speaking 6000 different languages. There are different kinds of religions such as Christianity, Catholicism, Islam, Buddhism, Taoism, and so on. All civilizations have their own features. However, they draw on each other's strength and constantly improve themselves, resulting in the making of such an abundant and colorful world.

Chinese philosopher Confucius said that two heads are better than one. It proves to be true in that the world makes progresses as all countries learn from each other. The Chinese invention of gun powders and compass accelerated the western countries' stepping into modern society. The learning of advanced technology from the western countries also promoted the development of the Chinese natural sciences. Ancient Chinese philosophers Confucius and Mencius are well known here and Chinese cultures have made deep tracks in Poland, such as the Chinese Alley in the Lazienki Park and the Chinese Pavilion at Wilanow Palace.

Likewise, Copernicus, Madame Curie, Adam Mickiewicz, and Chopin, the great polish figures are also known and respected by the Chinese people.

After equality and mutual trust are founded and inclusiveness and mutual learning are in practice, we can make peaceful development possible via win-win cooperation. The awareness of the Community of Common Destiny is to be raised. Every nation should accommodate the legitimate concerns of others when pursuing its own interests and should promote common development of all countries when seeking its own development. A new type of global development partnership which is more equitable and balanced shall be established so that all countries are pulled together in times of trouble, share rights and responsibilities, and boost the common interests of mankind. Problems of traditional and non-traditional security can be effectively resolved only when countries take part in candid and in-depth dialogues and consultation, comprehensive and sustained exchanges and cooperation. A win-win situation can be reached only when all countries' confluence of interests are concerned and expanded under the principles of cooperation for peace, for security and for the exchange of the plough for the sword.

This year marks the 50th anniversary of the Élysée Treaty. The Franco-German reconciliation serves as a good example for the win-win cooperation. After years of joint efforts and sincere cooperation, the two countries have shown the world how the two former enemies can take the path of win-win cooperation and make deep and long-lasting contribution to regional peace.

Conversely speaking, any nation could end up being blamed by the international community and punished by history if it tried to maximize its own interests by ignoring or even at the expense of other countries' interest. Its failure is just like sowing the wind and reaping the whirlwind. When World War II broke out in 1939, the allies sold Poland out and dreamed to live by the policy of appeasement. However they paid a heavy price for their action in less than a year's time.

China understands very well the importance of win-win cooperation. We have committed ourselves all the years and together with the international community to confront with the risks and challenges of mankind, and make our due contribution to the world stability and development.

China joined the World Trade Organization (WTO) in 2001. Since then, China has been importing commodities valuing about US$750 billion on an annual

average, which is equivalent to having created more than 14 million jobs for the relevant countries and regions.

As the largest emerging economy in the world, China has contributed over 20% to the annual world economic growth in consecutive years and became an important engine to push the world out of economic crisis.

After the breaking out of global financial crisis and the European debt crisis, China, together with the international community, acted in a cooperative spirit to cope with the difficulties and made major contributions to the stability and recovery of the world economy. Last year when Chinese Premier Wen Jiabao met with leaders from 16 central and eastern European countries in Poland, he proposed to set up a special loan of US$10 billion and a cooperative fund of US$500 million, which will enhance the economic and trading cooperation between China and the 16 countries and at the same time promote the economic development of the relevant countries.

China has sent about 21,000 personnel successively to 30 United Nations peacekeeping operations. We are the largest contributor of peacekeepers among the permanent members of the UN Security Council.

China actively takes part in international operations concerning anti-terrorism, non-proliferation of weapons of mass destruction, response to climate change, food and energy security, major natural disaster relief, and so on.

China has participated in more than 100 intergovernmental organizations at international level and signed more than 300 international treaties. She is actively involved in the international system and builds and contributes to the system.

Peaceful development is a new path China has explored and pursued. For more than 60 years since its founding, the People's Republic of China has achieved the success that attracted worldwide attention in its modernization drive. In the 30 odd years after the opening and reform policy was introduced in particular, China's economy has been undergoing a rapid growth with an annual average rate of 9.9% and residents' income grew at an average annual rate of 7.4%. For 2012, China's GDP reached 51.93 trillion RMB (equivalent to about US$ 8.2 trillion), an increase of 7.8%, becoming the world's second largest economy. Its total volume of import and export of the same year reached US$ 3.87 trillion, becoming the

world's largest trade body. And the total grain output was 589 million tons, for which the problem of feeding the population of 1.3 billion was solved successfully. The country is undergoing new changes constantly.

A more developed China will be more closely linked with the world. And a peaceful international environment is more needed for China's development. A prosperous and stable China will not be a threat to any country. It will only be a positive force for world peace and development. China will unswervingly follow the path of peaceful development, aiming at achieving self development by way of safeguarding world peace and vice versa.

China and Poland are situated in Asia and Europe respectively but we have similar historical experiences, both gone through vicissitudes. The Old Town in Warsaw is a historic witness. Actually the site is not old at all. History told us that during World War II, 85% of the buildings in Warsaw, including the Old Town area, was razed to grounds. Yet in a few years time, the Polish people rebuilt the old town at the shocking "Warsaw Speed" with their intelligence and patriotic enthusiasm. As for China, during World War II, we were victims of the Japanese aggression and more than 35 million people were killed during the war. Both China and Poland understand very well about the importance of security and the preciousness of peace. I believe that all people, regardless of nationalities, share one dream. We all wish that the world could be peaceful and stable, nations could be rich, strong and prosperous, and people could live in peace and plenty.

The Chinese people cherish peace and have the desire for development. We sincerely hope that the international community including Poland would have a better understanding and offer support to China's sincerity and resolve to pursue peaceful development. China is ready to join hands with other countries in making continued efforts to the great cause of peace and development of mankind and in building an ever bright future for the whole world.

According to the Chinese zodiac, each year is associated with one of 12 animals. The year 2013 is the year of snake. And in Chinese culture, snake symbolizes good fortune, longevity, happiness and wealth. In conclusion, I wish that everyone will enjoy peace, good health and happiness in the year of the snake. And may our world be more peaceful and secured.

BLAST THREAT TO CRITICAL AND MILITARY INFRASTRUCTURE

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Abstract

Blast attacks to public structures and critical or military infrastructure present threats that must be taken seriously. In modern asymmetric conflicts, force protection engineering mainly deals with protection against explosions caused by IED's and the mitigation of blast effects. Protective measures are based on practical experience with blast effects on structures and personnel, or on modern methods such as simulations. Different methods can be used to assess and analyze possible effects of blast attacks on constructions. Simulations can be used to predict the effects of explosions and can help to discover adequate protection measures. The aim of the article is to briefly present the use of AUTODYN software as a possible way of predicting the effect of blast attack. Simulations in this field are applicable not only in the military but in critical infra-structure protection too. The protection of critical infrastructure against a terrorist attack is a one of the most challenging issue nowadays. Government experts face problems with appropriate countermeasures in the uncertain environment of unidentified IED threats.

Introduction

Terrorist attacks by explosives means have a long history. But in recent years, the explosive devices have become the weapon of choice for the majority of terrorist attacks. Such factors as the accessibility of information on the construction of

explosive devices, relative ease of manufacturing, mobility and portability, in connection with significant property damage and injuries, are the reasons for the significant increase in bomb attacks all over the world. In most of the cases, structural damage and the glass hazard have been major contributors to death and injury in the attacked buildings. As a target of such an attack a military object or public infrastructure can be chosen.

One of the biggest threats to both military installations and public objects is an attack by explosive means. Such factors as the accessibility of information on the construction of explosive devices, the relative ease of manufacturing, mobility and portability, coupled with significant property damage and injuries, are responsible for the significant increase in bomb attacks on public structures all over the world.

The most well known attacks by explosives are the bombing of the World Trade Centre in New York City in February 1993, the devastating attack against the Alfred P. Murrah Federal Building in Oklahoma City in April 1995 (see fig. 1a) and the recent collapse of both WTC Towers. There are a lot of lesser attacks all over the world that have underscored the attractiveness and vulnerability of urban areas and civilian buildings as terrorist targets. These attacks have also demonstrated that modern terrorism should not be regarded as something that could happen elsewhere, but rather that there is a lot of examples of bomb attacks on public infrastructure in recent years.

- The London bombings happened as a series of coordinated suicide attacks on London's public transport system during the morning rush hour of 7 July 2005. Fifty-six people, including the four suicide bombers, were killed in the attacks and about 700 were injured. Three bombs based on home-made organic peroxide-based devices exploded on three London Underground trains, a fourth exploded on a double-decker bus.
- Suicide bombings in the center of Moscow carried out during the morning rush hour of 29 March 2010, at two stations of the Moscow Metro, with roughly 40 minutes of interval between them. At least 40 people were killed, and over 100 injured. Two bombs were used with a force of up to 4 kg and 2 kg of TNT. Both bombs were packed with metal nuts, bolts and screws, to increase the destructive impact of the blasts.

- The Oslo blast attack in the Oslo's central government district on 22 July 2011. The explosion damaged a government building (see Fig. 1b) and blew out windows over more than a half-mile radius, filling the area with smoke and littering it with shards of metal. Seven people were killed and scores injured. The bomb was made from a mixture of fertilizer and fuel oil and placed in the back of a car parked in front of the government building.
- The blast in the Belarus capital Minsk on 11 October 2011. The blast occurred on a platform at one of Minsk's busiest underground station in evening rush hour. The explosive device, which had been packed with metal balls and had a strength equivalent to 5–7 kg of TNT, was apparently left under a platform bench. About 300 people were present when it exploded as a train came into the station. Twelve people were killed and 126 were injured.

Figure 1a, 1b. 1a: Alfred P. Murrah Federal Building in Oklahoma City; 1b: Government buildings shattered in Oslo

Threats

One of the biggest threats to both military installations and public objects is an attack by explosive means. The effect of the attack particularly depends on the amount and kind of explosives used in the explosion. An attack by explosives can be generally done in the shape of a small bomb or a vehicle bomb.

The high effectiveness of an IED is based on the simplicity of production, availability of resources and the rapid spread of relevant information by the internet. A similar situation can be found regarding non-military and public areas where a lot of different possible targets like public transport means or infrastructure systems

exist. These targets, because of the lesser level of protection against attack with explosives, are more vulnerable.

The effect of an attack specifically depends on the amount and kind of explosives used in the explosion. There are a lot of explosives that can be utilized for IEDs production. Depending on sources and availability either military or commercial explosives can be used. Another possibility is the utilization of homemade explosives mostly based on perchlorates, hydrogen peroxide mixtures (triacetone triperoxide – TATP) or a mixture of ammonium nitrate fertilizer and fuel (ANFO). Ingredients for homemade explosives are easily obtained on the open market and that's why they are frequently used to produce vehicle bombs.

Explosives

There are a lot of explosives that can be utilized for small bomb or vehicle bomb production. Explosives are generally categorized as high-order explosives (HEs) or low-order explosives (LEs). HEs produce a defining supersonic over-pressurization shock wave. Examples of HEs include TNT, C-4, Semtex and nitro-glycerine. LEs create a subsonic explosion and lack HE's over-pressurization wave. Black-powder or gunpowder is an example of such an LE.

Depending on sources and availability either military or commercial explosives can be used. Another possibility is the utilization of homemade explosives mostly based on perchlorates, hydrogen peroxide mixtures (triacetone triperoxide – TATP) or a mixture of ammonium nitrate fertilizer and fuel (ANFO). Ingredients for homemade explosives are easily obtained on the open market and that's why they are frequently used to produce vehicle bombs.

Attacks by explosives can be generally done in the shape of a small bomb or a vehicle bomb.

Small bombs can be delivered as a mail bomb; hand delivered in a briefcase or rucksack or can be worn by a person such as suicide bomber or can be placed such as with a pipe bomb, for example. A suicide bomb can be contained in a vest, belt, or clothing that is specifically modified to carry this material concealed. A small bomb can cause the greatest damage and casualties when brought into the

vulnerable, unsecured areas of a building interior, such as the building lobby, mail room, and retail space or underground stations. Recent events around the world make it clear that there is an increased likelihood that bombs will be delivered by persons who are willing to sacrifice their own lives. Hand carried bombs and suicide bombs are typically in the order of two to five kilograms of trinitrotoluene (TNT) or equivalent. However, larger charge weights, in the 5 to 50 kilograms TNT equivalent range, can be readily carried in rolling cases. Mail and pipe bombs are typically less than five kilograms of TNT equivalent, ordinarily to two kilograms.

Vehicle bombs (VBIED) are able to deliver a sufficiently large quantity of explosives to cause potentially devastating structural damage and that's why they present the biggest threats to Military or critical infrastructure components. They present one of the biggest threats to military installations such as a Forward Operating Base (FOB) or a Main Operating Base (MOB) and they can result in a greater effect on the target. The explosion within or immediately nearby a military installation can cause huge damage to constructions, the collapse of protective walls, projections of fragments and casualties that can occur as the result of the direct blast effects. Subsequent damage as well as casualties can be caused by the collapsing of constructions or secondary fragments. The vehicle bomb's size can be calculated on the basis of the loading capacity of a vehicle.

For practical reasons representative bombs are used and their explosive capacity are given in table 1 for civilian use and in table for military use.

Representative bomb		**Explosive capacity [kg]**
Small bomb	Mail or pipe bombs	< 2
	Hand carried bombs and suicide bombs	2–5
	Rolling cases bombs	5–50
Vehicle bomb	Motorbike	50
	Passenger vehicle	400
	Van	1 500
	Medium truck	4 000
	Box van, fuel truck	13 000
	Semi trailer	27 000

Table 1. Explosive capacity of representative bombs [1], [2]

	A Small / medium calibre projectiles	B Shoulder launched weapons / Rifle grenades	C Battlefield rockets, Artillery and Mortars	D Small / Personnel-borne IEDs	E VBIEDs
5	Automatic cannon 30 mm APDS	Advanced ASM Anti Structure Munition	155 mm artillery 122 mm rocket	Bag / Suitcase 20 kg TNT	Heavy truck / similar > 4000 kg TNT
4	Heavy machine gun 12.7 – 14.5 mm AP	Anti-tank Shaped charge	120 mm mortar 107 mm rocket	Body-borne device 9 kg TNT, fragments	Medium truck 4000 kg TNT
3	Assault / Sniper rifle 7.62 mm AP WC	Anti-personnel Thermobaric charge < 2.5 kg / Conventional	82 mm mortar	Large briefcase 9 kg TNT	Van 1500 kg TNT
2	Assault rifle 5.56 – 7.62 mm AP	40 mm Rifle grenade Shaped charge	60 mm mortar	Package 1.5 kg TNT	Passenger vehicle 400 kg TNT
1	Assault rifle 5.56 – 7.62 mm Ball	(Reserved)	Hand grenade	Letter bomb 0.125 kg TNT	Motorbike 50 kg TNT

Table 2. Existing Design Threat Level Table according to STANAG 2280.

Explosion effects

When an explosive charge is detonated in the air or on/in the ground, there are several primary effects (see Fig. 2) that should be considered: air blast, fragmentation, crater ejecta, ground shock, and thermal effects (heat).

1. *Air blast* is the basic effect from any detonation event with uncased or cased explosives. The elements of air blast that will be observed at the exposed site are the peak incident overpressure, the blast impulse, and the dynamic pressure (air flow).
2. *Fragmentation* is generally considered to be of two types. Depending on their origin, fragments are referred to as primary or secondary fragments.
3. *Crater ejecta* can also result from explosive events and can cause the same effect as secondary fragments.
4. *Ground Shock* is the coupling of energy into the ground as a result of a detonation or explosion.
5. *Thermal effects (heat)* are usually associated with the fireball that is produced by an explosive event.

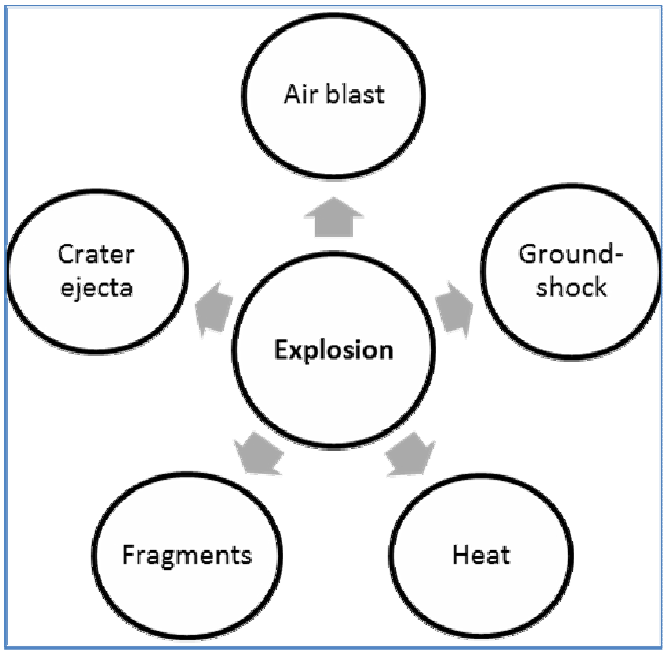

Figure 2. Explosion effects

The most structural damage to a construction from an external explosion is caused by the response to air blast, fragment impact, and ground shock.

The extent and severity of damage and injuries in the result of an explosive attack can be assumed on the base of the amount of explosive, distance from the explosion site, and assumptions about the construction.

Damage due to the air blast may be divided into direct air blast effects and progressive collapse.

Direct air blast effects are caused by the high-intensity pressures of the air blast in the proximity of the explosion site. These may induce localized failure of exterior walls, windows, roof systems, floor systems, and columns. Progressive collapse is referred to as the spread of an initial local failure from element to element, eventually resulting in a disproportionate extent of collapse relative to the zone of initial damage. Localized damage due to direct air-blast effects may or may not progress, depending on the design and construction of the building. To cause a progressive collapse, the bomb must be in close proximity to a critical

load-bearing element. Progressive collapse can propagate vertically, upward or downward, from the source of the explosion, and it can propagate laterally from bay to bay as well.

The pressure that an explosion affects on construction surfaces may be several orders of magnitude greater than the loads for which the construction is designed. The shock wave also acts in directions that the construction may not have been designed for, such as upward pressure on the floor system.

Assessment of blast effects

Different methods can be used to analyze and assess possible subsequent effects of a blast attack to any target. The simplest method is empirical calculation with basic results; the most sophisticated method is numerical simulation.

The crucial problem of each calculation or simulation is the number of suitable evaluation criteria. It is possible to use a numerical simulation of damages due to air blast or impact on structural fist members but concerning the whole structure the simulation is restricted by computer and software limitations – a 3D simulation of steel or concrete structural member hit by pressure wave costs millions, has many equations and takes several days or weeks for a solution for 100–500 milliseconds of effects.

To calculate basic data for assessing a structure, three main methods can be used:

- Empirical calculation based on scaled distance from the TNT charge and empirical formulae of overpressure, pressure impulse and the time of arrival and time of duration;
- A semi-empirical calculation based on the same formulae as previously but for simple geometries, some software tools can be used for calculation (e.g. ConWep and BlastX from U.S. Army Corps of Engineers, Protective Design Centre, or Mathcad handbook DynamAssist);

- Numerical method based on explicit solution of motion equations, appropriate solver is often part of complex simulation software and can solve complex geometry and loading conditions.

Empirical calculations of the blast effect are mainly focused on the spreading of pressure a wave in the air and the calculation of overpressure for both types of burst – air burst and surface burst (see Fig. 3). Numerical methods based mainly on Euler or Lagrange solver allow us to compute a complex simulation where pressure, velocities and deformations are basic output data at each point of simulation and damage levels, strains and other structural characteristics are available too.

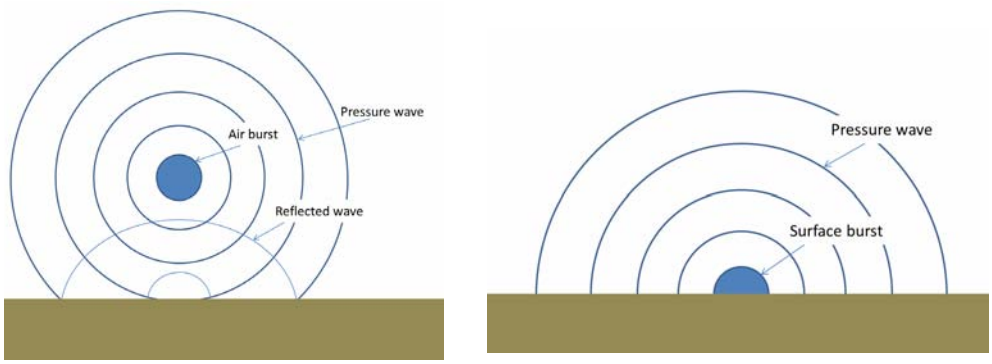

Figure 3a, 3b. 3a: Spherical free air burst, 3b: Hemispherical surface burst

Regarding VBIEDs, as a result of applied protective structures and safety measures VBIEDs cannot get into the interior of a military installation and therefore the main effect of the explosion will be an intensive air blast wave impacted on perimeter and entrance structures and some of the characteristic parameters of the wave can be calculated. By comparison with the following table we can estimate the range of damage or injury.

Damage Object	Occasional	Minor damage	Medium damage	Heavy damage	Destruction
	Overpressure Δp [kPa]				
glass, large window	0.2	–	–	–	–
glass, typical window	–	1.1	–	–	3.5 – 7.0
concrete wall, 20–30 cm	–	–	–	14–21	–
brick wall – completely demolished	–	–	–	56.3	70.3
brick wall, 20–30 cm – fail by flexure	–	–	–	–	56.3
brick wall, 45 cm – completely demolished	–	–	–	–	91.4
steel building	–	9.1	14.0	17.6	21.1
wooden building	–	–	12.0	17.0	28.0
industrial building	–	–	28.0	–	–

Table 3. Damage criteria for structures or components due to overpressure – examples [kPa]

Empirical calculation

Most structural damage from an external explosion is caused by response to the airblast. In general, the effect of the blast specifically depends on the standoff and on the amount of energy released by a detonation represented by the amount of explosives. The standoff is the distance measured from the center of gravity of the charge to the component of interest. The bomb size depends on the delivery capacity of the attackers and for basic calculation representative bombs are used.

To calculate the essential airblast parameters of the representative bombs, particularly VBIEDs, and use these calculated parameters for the assessment of the airblast effects on protective structures and either to set down safety distances or to design adequate force protection measures, simple relations can be applied. For this calculation symbols given in Table 4 are used.

Symbol	Dimension	description
E^d	$J \cdot kg^{-1}$	Specific detonation energy
^{Ed}TNT	$J \cdot kg^{-1}$	Specific detonation energy of TNT
NEQTNT	–	TNT equivalent factor
P_a	MPa	Atmospheric pressure
P_r	MPa	Peak reflected overpressure
P_{SO}	MPa	Side-on overpressure
q_0	MPa	Dynamic pressure
Q_{TNT}	kg	TNT equivalent charge
Z	$m \cdot kg^{-1/3}$	Scaled distance

Table. 4: Symbols used.

In general, the relations used to calculate airblast parameters are based on the use of pure TNT charges. For calculations related to other explosives it is necessary to use the corresponding TNT equivalent charge calculated on the basis of TNT equivalent factors (see equation 1 and 2), given in Table 5. The estimation of the airblast parameters at different distances in relations to different charge masses can be given by the scaled distance Z (see equation 3) that represents correlations between a particular explosion and a standard charge of the same explosive.

	Detonation velocity	**Bulk density**	**TNT equivalent factor – NEQTNT**
Explosive	/$m \cdot s^{-1}$/	/kg·m-3/	–
ANFO	3 200	0.84	0.82
Composition B (TNT/RDX 40/60)	7 470	1.60	1.11
Composition C4	8 040	1.63	1.37
Pentolite (TNT/PETN 50/50)	7 460	1.66	1.42

Table. 5: Representative explosives and their TNT equivalent factors

TNT equivalent factor – NEQ_{TNT}

$$NEQ_{TNT} = \frac{E^d}{E^d_{TNT}} \tag{1}$$

TNT equivalent charge – Q_{TNT}

$$Q_{TNT} = Q \cdot NEQ_{TNT} \tag{2}$$

Hopkinson-Cranz scaling law for scaled distance – Z of a blast: [2]

$$Z = \frac{R}{\sqrt[3]{Q_{TNT}}} \tag{3}$$

The other basic characteristics of blast wave such as a side-on overpressure, shock front velocity, incident pressure, and incident impulse can be calculated according to equations in [2] and [3]

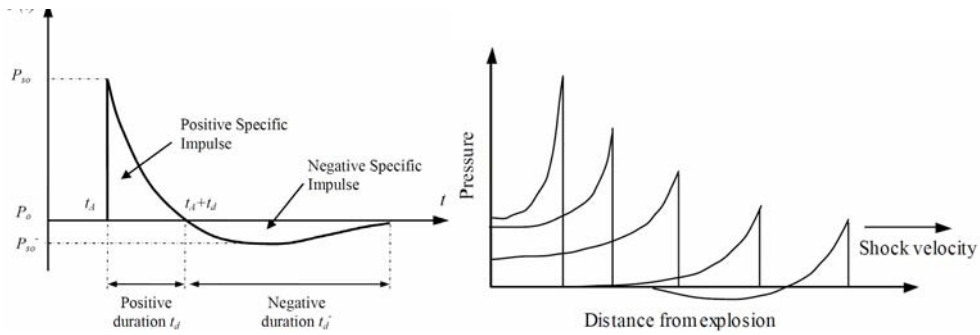

Figure 4a, 4b. 4a: Dependency of overpressure at given distance on time of duration after explosion; 4b: Chart of maximum pressure at distance from explosion

The following paragraphs show some examples of blast or impact simulations with different demands on hardware and computational time solved with AUTODYN software. These demands often rely on solver type, duration of incident and the possibility to simplify solution.

Numerical simulation

Numerical simulations are mainly based on an explicit solution of motion equations; an appropriate solver is often part of complex simulation software and can solve complex geometry and loading conditions. Numerical methods based mainly on the Euler or Lagrange solver allow us to compute complex simulations where pressure, velocities and deformations are the basic output data at each point of the simulation and damage levels, strains and other structural characteristics are available too.

Based on knowledge of blasting action and convenient software, the effect of a blast attack can be simulated to predict outgrowth of blast to the construction. An explicit solver such as ANSYS/AUTODYN can be successfully used for the simulation. The significant advantage of AUTODYN is a library of materials suitable for the simulation of explosions, blast effects, and impacts with appropriate material constants filled. For some material models an HPC and parallel computing on shared and distributed memory systems can be used.

Modern software tools like AUTODYN can help experts to properly assess threats in asymmetric conflicts at a reasonable cost. Due to the complex nature of the high velocity inter-action between bodies or blast wave spreading as well as the physical phenomena being analyzed, it is extremely important for the user of the tools mentioned to have a good understanding of the underlying assumptions and limitations of the models. ANSYS AUTODYN has been used in a vast array of projects including those concerning nonlinear phenomena. It is also possible to use it effectively for building protection measures and insurance risk assessments for blast effects in military bases.

Euler solver, 2D and 3D simulation of blast wave

Euler solver used in AUTODYN is very effective for the simulation of a blast pressure wave spreading in the air or the simulation of blast effect on a structure when a charge detonates some distance from the object of interest. The Euler solver uses the computational mesh that is fixed in the space of i-j (2D) resp. i-j-k (3D)

mesh (see Fig. 5). The mesh is not deforming, it remains the same in time. Materials are flowing across the mesh and therefore it is necessary to evaluate the transport terms of the mass, energy, and momentum at each computational step.

Special formulation of this solver was developed for the simulation of the pressure wave after a blast in the air; this is most effective solver for the calculation of a reflected pressure wave inside an urban area or inside buildings (see Fig. 6).

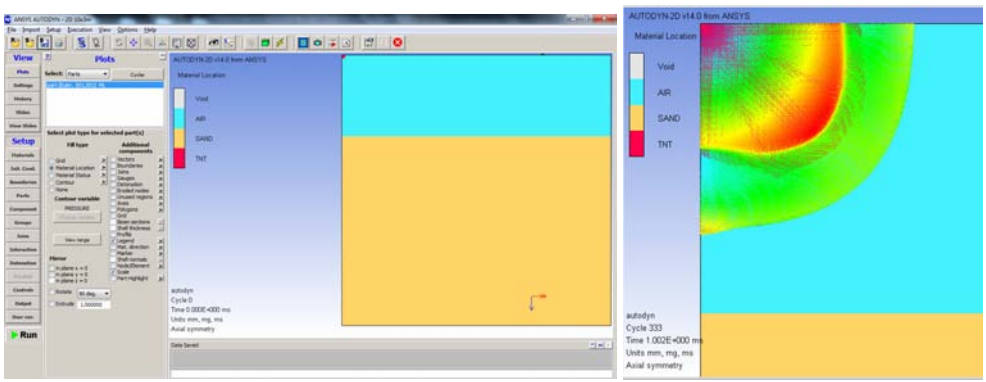

Figure 5a, 5b. 5a: 2D axis symmetry simulation of spherical free air burst – initial conditions in AUTODYN; 5b: Detail of "flowing" materials through 2D i-j mesh, 1 ms after detonation of TNT charge.

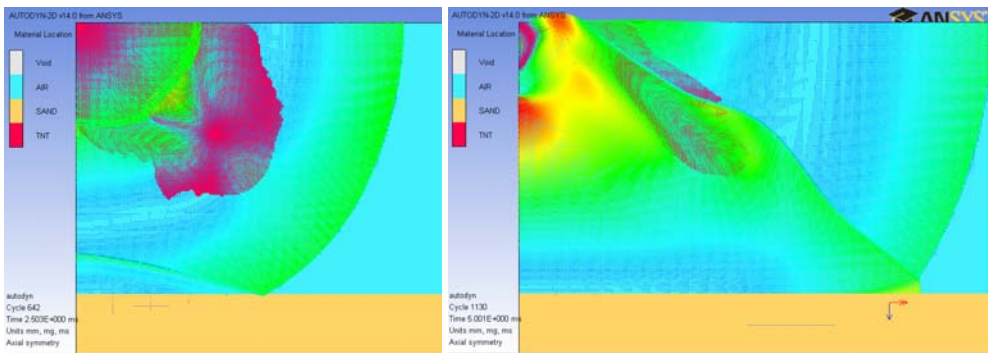

Figure 5c, 5d. 5c: Beginning of reflection of pressure wave, 2.5 ms after detonation of TNT charge, 5d: Initialization of "triple point" of reflected wave, 5 ms after detonation of TNT charge.

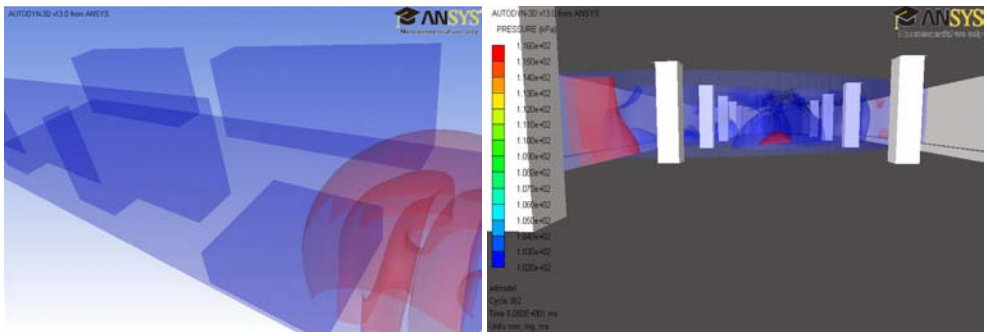

Figure 6a, 6b. 6a: Simulation of blast inside an urban area, 20 ms after detonation of TNT charge, 6b: Simulation of blast inside buildings, 50 ms after detonation of TNT charge

These simulations conducted at our department allow us to assess the consequences of a blast with criteria according to Table 3. The most important parameter is a pressure level; which can be measured during simulation at any point through gauges and later evaluated as a time dependency chart.

Lagrange solver, blast behind concrete protective wall

The Lagrange solver is effective for the simulation of the interaction of bodies, when one body penetrates the other (see Fig. 7 and 8). This solver uses the computational mesh that is connected with the continuum, in the same way as a classic FEM. Thus, it deforms in time following the continuum deformation. No transport terms are needed, a great disadvantage is the fact that the mesh is deforming and during the solution time this is the source of errors. The solution can be "rezoning or remeshing" technique but this introduces a new more regular mesh at certain times and therefore it introduces into the solution similar errors as in the transport terms above.

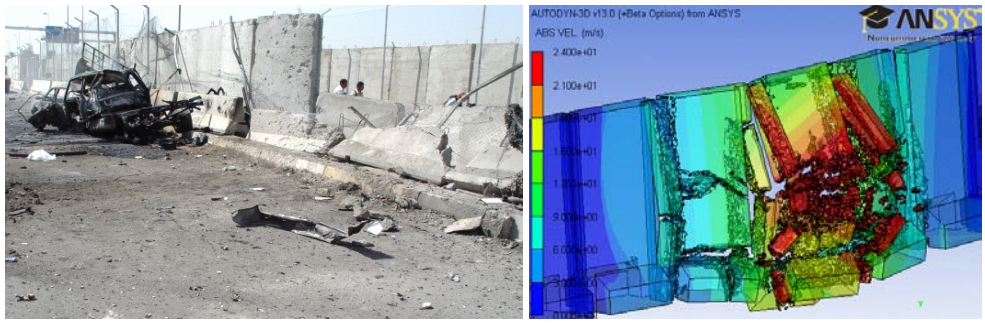

Figure 7a, 7b. 7a: Damaged protective wall after VBIED atack, 7b: Simulation of blast behind T-Walls, 25 ms after detonation of TNT charge

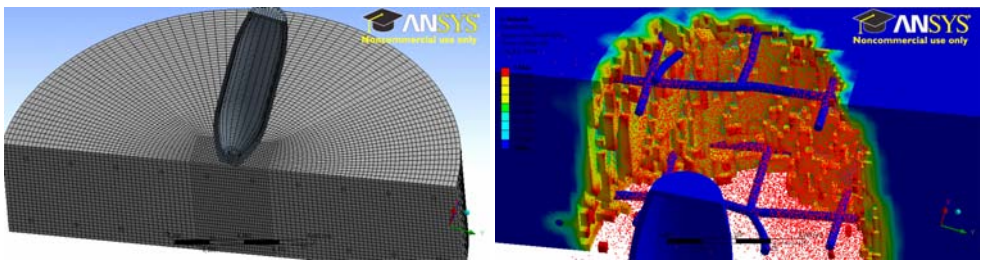

Figure 8a, 8b. 8a: Simulation of the penetration of projectile into RC slab – Lagrangian mesh, 8b: Simulation of the penetration of projectile into RC slab – damages after 10ms

These kinds of simulations allow us to assess for example the interaction between bodies after an explosion or damage level inside bodies subjected to a blast wave. The most important parameters are impact velocity, damage level and strain of materials; this result can be animated and this gives us a good view into the mechanism of this incident.

Entry Control Point of Military Base

One of the biggest threats to military installations such as a Forward Operating Base (FOB) or a Main Operating Base (MOB) is an attack by vehicle bombs (VBIEDs). The entry Control Point (ECP) is one of the most important parts of the perimeter, which is surrounds the military base. Every person and car entering the base has to go through this point. For this reason there is high requirement

to position it properly and also built it from appropriate materials. The failure to comply with the main principles leads to a massive loss of life, weapons and other stuff. A VBIED explosion within or immediately nearby a military installation can cause huge damage to constructions: the collapse of protective walls; the emission of fragments causing harm as well as the casualties that can occur as a direct result of the blast. Subsequent damage as well as casualties can be caused by collapsed constructions or secondary fragments.

As a result of applied protective structures and safety measures VBIEDs cannot get to the interior of a military installation and therefore the main effect of the explosion will be an intensive air blast wave impacted on the perimeter and entrance structures. In the case of a VBIED attack it is assumed that there will be used a cube shaped explosive charge and it will be placed in a close proximity to the ground. As a result, the air blast wave will spread as a hemispherical air blast wave and then some of the characteristic parameters of the wave can be calculated. Based on these preconditions a numerical simulation can be done to predict the effects of an attack or to design adequate force protection measures.

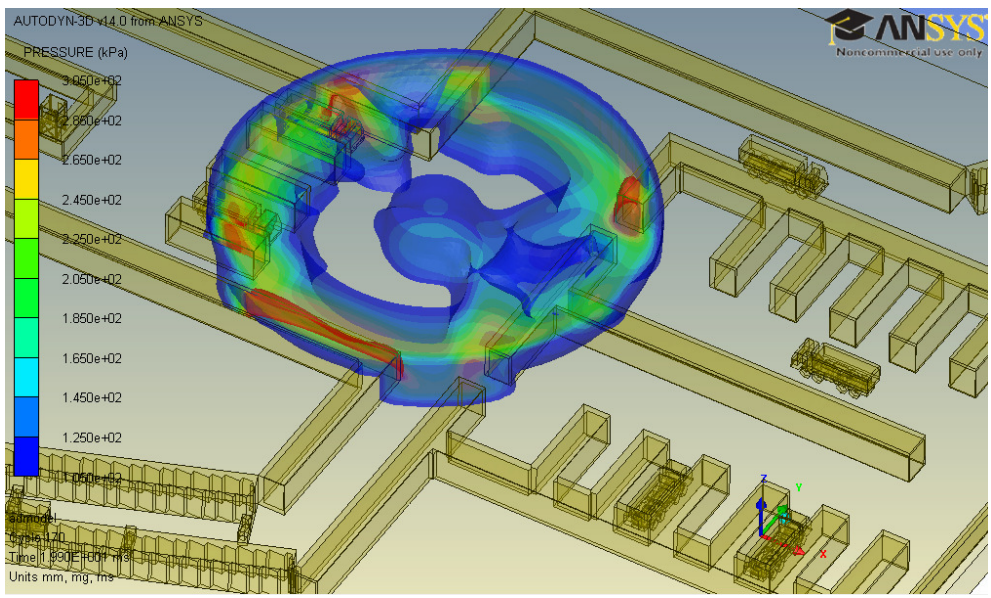

Figure 9. The explosion of a 1000 kg of TNT between control zone and parking, time – 20 ms

Despite all these barriers the enemies can overcome the ECP and initiate the VBIED. With the blast of such a big quantity of explosives a large blast wave formed which crucially destroys humans and material at the base. The knowledge of the blast wave spreading and its size are important for a better arrangement of the ECP and also to improve the protection of the base. For this reason there is a need to know how the blast wave will spread at the entrance.

Critical infrastructure in transportation

One of the possible objects that can be attacked by terrorists is the public transport system, primarily a metro (underground railway). Terrorists can carry out any attack in a metro station by bringing in a charge, hidden in personal luggage or belted on the body under a coat. They can use several charges in one station, but simultaneous detonation or detonation with controlled initiation is unlikely in this instance. Assuming a brought in charge, an attack will be against people with a significant pressure wave and fragmentation effect. Damage to the station will not lead to collapse of the whole structure, but damages to equipment and auxiliary and service structures could be significant.

An attack aimed at the collapse of the whole station structure is less probable, it needs more than several hundred of kilograms of explosives (a vehicle bomb is assumed). Under-surface stations are relatively secure against this kind of attack. Surface stations are similar targets to other public buildings, but less attractive.

It is supposed that in a similar situation as in the Moscow metro, but rather a suicide attack will be conducted on a platform just before the train enters the station, when the platform is full of people. An explosion is in the middle of the platform between the train and the wall, its height is 1 m. It is assumed to be a belt charge of 10kg TNT. The simulation was conducted in two steps.

Figure 10a. Metro station

Firstly, the detonation and pressure wave formation was modeled. Secondly, the pressure wave was remapped on to a metro platform and the spread of pressure wave was calculated.

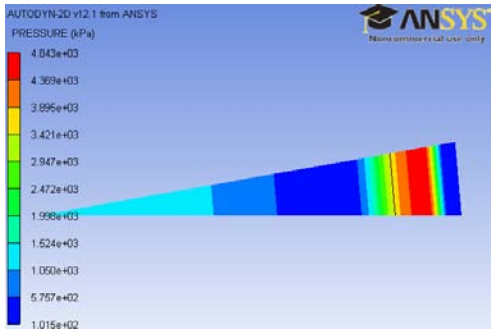

Figure 10b. Explosion of 10 kg of TNT

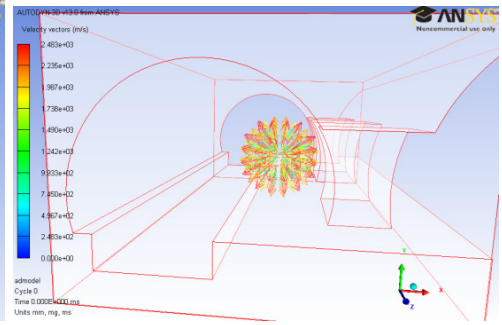

Figure 10c. Pressure wave remapped on to platform

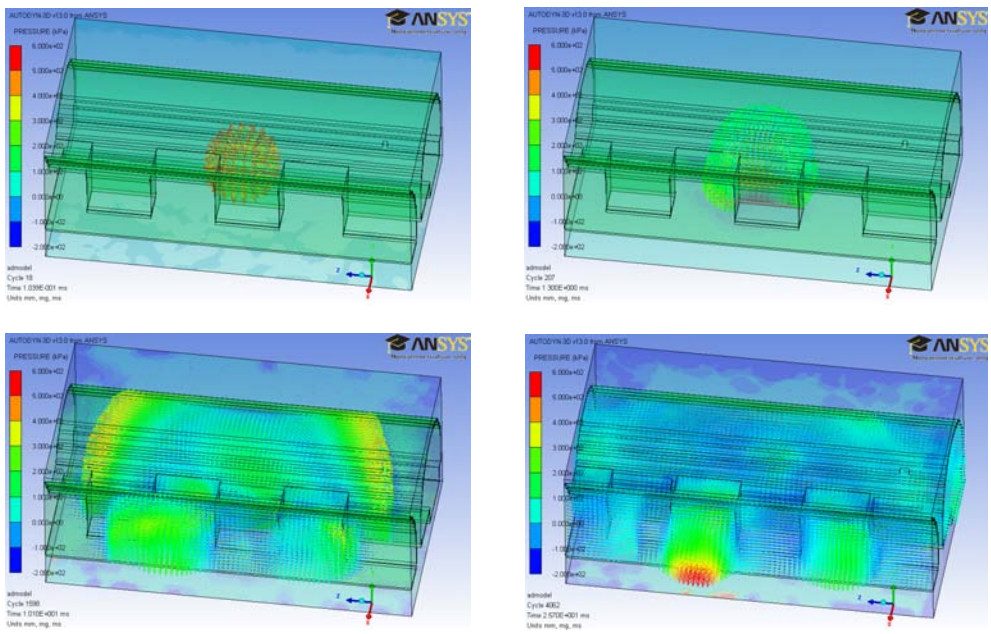

Figure 10d. Pressure wave calculation

Conclusion

Explosive means, mostly VBIEDs, present very effective and relatively easily available means of attacking public installations. They are increasingly used because of their simplicity and availability. Many protective structures are used on the basic of their actual efficiency but some of them can pose a threat to the protected objects. Simple calculation of the airblast parameters concerning VBIEDs can be helpful to engineers to plan the application of proved protective structures. To design new or verify currently used protective structures the numerical simulation should be applied to get results which correspond to the actual threat.

Based on the knowledge of blasting actions and convenient software the effects of a blast attack can be simulated in order to predict blast outgrowth to constructions. Modern software tools like AUTODYN can help experts to properly assess threats in asymmetric conflicts at reasonable cost. Due to the complex nature of the high velocity interaction between bodies or a blast wave spreading and the physical phenomena being analyzed, it is extremely important for the user of the aforementioned tools to have a good understanding of the underlying assumptions and limitations of the models. The advantage of AUTODYN SW is a library of materials suitable for simulation of explosions, blast effects, and impacts with appropriate material constants filled.

A significant limitation for all of these tools is in defining realistic failure criteria for both the structural elements and people. Depending on the scenario, the failure criteria for a person may be set as a blast able to cause a burst ear drum or internal injuries; for another scenario it may be set to a higher blast level to cause significant injury or fatality. One area that has major limitations is the failure of components from combined blast and fragment damage.

Projected or applied protective measures are mostly based on practical experience with blast effects on structures and personnel. In addition to practical experience modern methods such as simulations can be effective. Simulations can be used to predict the effects of an explosion and can help to find out adequate protection measures. Simulations in this field are applicable not only in the military but in the critical infrastructure protection too. Simulations of blast wave interaction

with protective concrete walls can help the experts understand the physics and then find the proper solutions for a particular structure.

A VBIED explosion within or immediately nearby a military or critical infrastructure object can cause huge damage to constructions, the collapse of structural members, projections of fragments and casualties that can occur as a result of the effects of a direct blast. Subsequent damage, as well as casualties, can be caused by collapsed constructions or secondary fragments.

There exists many safety measures and protective structures to prevent a VBIED from reaching a target and therefore the main effect of the explosion will mostly affect the protective structures used. One of the most widespread protective constructions is a concrete T-wall but in the case of a VBIED this construction can be not be seen as protection but is responsible for additional damage and casualties due to its downfall or shattering.

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RELATIONSHIP BETWEEN THEORY AND DOCTRINE OF OPERATIONAL ART

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Abstract

The theory and doctrine of Operational Art and their relationship is a significant issue for the theoretical development of Operational Art due to its orientation towards the application of the practical activity of people in the operation. The issue of the scientific development of the theory of Operational Art cannot be considered only as a state but as a process, as well. The theory of Operational Art includes objective facts, and other structural elements of the theory of operation, obtained by studying its past and present. On this basis, the theory of Operational Art provides its future form and characteristics. Therefore, the authors in this paper examine in detail definitions of the terms theory and theory of Operational Art, definitions of the term doctrine, military doctrine and doctrine of Operational Art and finally the relationship between theory and the doctrine of Operational Art.

Key words: Operational Art, theory, theory of Operational Art, doctrine, doctrine of Operational Art

Introduction

Operational Art is one of the fundamental Defense Sciences (Military Sciences).[1] In order to accept an area of human knowledge as a science it is necessary to have relevant constituents: an authentic subject of research, a theory with coherent scientific facts, a method for the cognition of its main subject and the language.

These are the essential constituents of every science. Also, the philosophy of science has clearly established that all applied sciences (and thus the Operational Art) have doctrine as their constituent.

Since this fact has been neglected, the doctrine is often equated with science, which causes a major logical mistake. Also, the doctrine is the result of applied science (as Operational Art is), respectively, and of its theory. To eliminate these dilemmas, it is necessary to have further understanding of the terms theory and the theory of Operational Art, and the defining the concept of doctrine, military doctrine, and therefore the relationship between the theory and doctrine of Operational Art.

Defining the Concept of Theory and Theory of Operational Art

The term *theory* has its origins in the Greek language meaning "consideration" and "observation".[2] Later, the term has been used in the sense of the acquired, recorded and preserved human knowledge, regardless of whether it is true. In the literature, there is no single accepted definition of the term.

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1 The phrase "Defense Science" in the past forty years, has most often been called a military doctrine or system of Military Sciences, then the Art of War, and in some papers of military theorists, Polemology. After the scientific symposium "Defense Sciences – 2011", held from 07 to 08 April 2011 in Belgrade and organized by the Military Academy, the Human Resources Sector of the Ministry of Defense of the Republic of Serbia, the view was taken that instead of the above terms the future papers should use the phrase "Defense Science", so in accordance with the above, this phrase will be used below in this paper.

2 ŠULJAGIĆ, Radosav, *Teorija ratne veštine – naučna izgrađenost teorije jugoslovenske ratne veštine* (PhD thesis), UVJ, Belgrade, 1993, p. 20-21.

Differences in the theories are primarily a consequence of considering different concepts. The term *theory* is used to denote the concept of *theory in general*, but also to highlight the notion of *theory in the strict sense* (theory of science and scientific theory). The theory in general refers to all the knowledge acquired through the mental-cognitive activity of people.[3] In this, the knowledge about subjects and processes relates to nature, human society and the human psyche. The theory in general includes the complete and incomplete, scientific and unscientific, true and false knowledge. It is a result of considerations that are characterized by: "... externality, meaningfulness, comprehensiveness, specificity and logical connection".[4]

It does not meet the requirements of science, and, accordingly, is not scientifically based. Theory in general is also a mental-cognitive activity of a large number of people. It primarily relies on the sensory awareness of people (experience) and sometimes loses its logical connection. Theory, in general, is a mental-cognitive activity by which people acquire knowledge about the world, and the very knowledge that is written and otherwise recorded serves as a support for the improvement of human practice.[5]

Theory in the strict sense is based on relatively objective experience and has a scientific character. The rational component of human activity is significantly more prevalent than in the general theory. In addition, theory in the strict sense is much more systematic and proven. Thus, it allows a deeper grip of the knowledge of reality. It multiplies, conditioned by practice. Its mental-cognitive activity begins with the detection of a problem in a particular area of reality – in practice. Theory in the strict sense explains the subjects and processes, real and imagined, based on the previously defined elements of its structure. It includes the knowledge that, completely and for a certain historical time and space, it objectively reflects part of the reality. With this, it contains dialectics as its main quality. This enables its development and the adequate monitoring of changes in the reality to which it refers. Therefore, in the strict sense, the theory includes mental-cognitive activity, in which people, in science, acquire, record and store knowledge about a particular area of reality.

3 Ibid, p. 20-32.
4 Ibid, p. 22.
5 Ibid, p. 23.

For human society and its practices all true theories about the phenomena taking place around man are important. However, it is believed and confirmed in human practice that the *theory of science and scientific theories* are most important for the further development of human practice, direct cognition and changing objective reality, as well as acquiring true knowledge of that reality and work processes. Many authors believe that the theory of science and scientific theories are theory in the strict sense. These two aspects of theory are often used interchangeably and are interpreted differently; therefore it is necessary to point out their substance.

Each particular science has a considerable fund of knowledge about its research subjects, or the parts of reality that are investigated, reported and studied within that science. This knowledge is on different levels of generality. It just shows that some of the sciences are at different stages of scientific development. However, this does not mean that their knowledge skills are isolated parts. On the contrary, they are in a more or less mutually coherent and comprehensively dependent relationship. This relationship directly affects the whole of science and its theories. For the theory of science, defining is the knowledge gained in the mental-cognitive activity of people, recorded, preserved and still being gained and used to meet certain human needs. Thus, the theory of science "includes a special mental-cognitive activity by which the scientific knowledge is acquired, recorded and preserved, as well as all the recorded and preserved theoretical knowledge of the subject of science and the reality of the nature, the human society and the human psyche".[6]

Similarly to science, the theory of science contains a number of theories of specific sciences and their scientific disciplines. They are mostly in relation to each other as general – particular – individual. The theory of science, for example, is – general, the theory of a particular science – particular and a theory of specific scientific discipline – individual.

Based on the above, one can easily conclude that the theory of a particular science involves "special mental-cognitive activity by which the scientific knowledge of the subject of the science is acquired, recorded and preserved, and on the part

6 ŠULJAGIĆ, Radosav, *Prilog razumevanju ratne veštine*, "Vojno delo", No. 1/1995, Belgrade, p. 13.

of reality that the science explores and learns about".[7] In addition, this theory also includes the "methodical correctly connected, integrated and systematized general theoretical and experiential attitudes with which this science collates data based on experience, explains empirical phenomena in that part of reality that is the subject of its research and directs future research."[8]

In the theory of a particular science, scientific theory is a description, classification and scientific explanation of a phenomenon or group of phenomena, based on scientific principles, laws and hypotheses. It is usually expressed as the thoroughly developed and tested hypothetical position of a scientific law or hypothesis applied to the considered phenomenon or group of phenomena in a particular part of the subject matter of this science. Hence, a scientific theory is always a narrow term and usually of a lower level of generality than the theory of science. As a result, the theory of science and scientific theory are in relation – general compared to the particular, and vice versa. Exceptions are only scientific theories whose subject integrally includes parts of the subjects of more sciences, groups of sciences and their scientific disciplines, or possibly one science. Scientific theory is usually the most important part of the theory of science. It is the mainstay of the other elements of the theory of science by providing constant checking of their veracity, relevance and coherence. Also, it provides the most general and systematic scientific knowledge, which is directly reflected in its structure and the structure of the theory of science. Thus, it is continuously developed and improved by knowing individual or group subjects or processes in the part of reality that is explored and learned in a particular science.[9]

Based on the general definition of theory, the initial definition of the term theory of Operational Art can be considered.

Initial determination of an area, and thus the Operational Art, is based on its general characteristics, which are relatively reliable and serve as a broader framework for consideration of a particular term. The definition of the theory of Operational Art is based on the general features of the theory and qualitative

7 ŠULJAGIĆ, Radosav, *Prilog razumevanju ratne veštine*, "Vojno delo", No. 1/1995, Belgrade, p. 13-14.
8 Ibid, p. 14.
9 Ibid, p. 16.

progress in the theory of Operational Art through history. In doing so, we bear in mind the different understanding of the theory of Operational Art in different countries and the lack of a universally accepted definition of Operational Art.

The subject of the theory of Operational Art is operation as a social phenomenon. Since the study is focused on combat actions in operations and operations, it is part of the theory of Defense Science. As for the extent of scientific development of the theory of Defense Science and the theory of Operational Art, it aspires to a scientific theory. This is best illustrated by the historical development of Operational Art. There is no doubt that the theory of Operational Art has been developed in the professional sense, and that it allows the practice of Operational Art as a skill. Modern theory of Operational Art is the result of the scientific approach to solving many problems.[10] In this, it appears in the form of recorded stored knowledge about operations, in various professional, scientific and military doctrinal documents. This knowledge supports new knowledge and initiates the expansion of issues in this area. The theory of Operational Art also includes the mental-cognitive activity through which the knowledge has been acquired. This activity allows for the combination of sensory-cognitive and rational-cognitive components of man in the area of operation. It is directed towards the understanding of the clearly defined social phenomena of reality.

It is thus possible to derive the initial determination of the theory of Operational Art. Thus, the term theory of Operational Art comprises all recorded and preserved knowledge of operations which is used to understand a specific operation, as a social phenomenon and a part of reality, and direct the activity of people in it. In a broader sense, the theory also means all the knowledge related to other constituent elements of Operational Art (theory, method, language, etc.). This takes into account the cognitive reality of the scientific understanding of Operational Art and its practices, and therefore science, which in many aspects became interesting for various considerations.[11] The above initial determination

10 See more on solving operational problems in contemporary counterterrorist operations: TALIJAN, Miroslav, *Bezbednosni menadžment u suprotstavljanju i borbi protiv terorizma*, MA, Belgrade, 2010.

11 SLAVKOVIĆ, Rade, Teorijska izgrađenost operatike (Ph. D. thesis), MA, Belgrade, 2006, p. 77.

of the theory of Operational Art also enables the consideration of other issues in and about the theory. One of the most important is the issue of the doctrine of Operational Art, as well as their relationship.

Defining the Concept of Doctrine, Military Doctrine and the Doctrine of Operational Art

In military and other literature and lexicography, both ours and foreign, official and unofficial documents, it was very often said and written about doctrine as a quite disconnected and rather vague term. Thanks to the enthusiasm of some military theorists in recent years, significant progress has been made in explaining the essence of the concepts of *doctrine* and *military doctrine*.[12] In the etymological sense, the term *doctrine* means the system of learning, the system of adopted attitudes that are submitted as recommendations to practice, that is, by people for the purpose of practical action in a particular sphere of activity.[13] Today, the term generally refers to learning, and in order to grow into a doctrine "it should be arranged and presented as a system of stabilized statements in the form of standards and recommendations to practice".[14] A relatively long time ago, the philosophy of science unequivocally established that all applied sciences have

12 Among other things see – VIŠNJIĆ, Dušan, *Kako misliti doktrinu* (article), "Vojno delo", No. 1/1995, NIU "Vojska", Belgrade, p. 34-47; VIŠNJIČ, Dušan, *Pokušaj identifikacije koncepcije ratne veštine i njenih filozofskih pretpostavki* (article), "Savremeni problemi ratne veštine", No. 24/1992, CVVŠ OS "Maršal Tito", Belgrade, p. 25-38; SAKAN, Momčilo, *Vojne nauke*, Military Academy, Belgrade, 2003, p. 53-57; ŠULJAGIĆ, Radosav, *Teorija ratne veštine – naučna izgrađenost teorije jugoslovenske ratne veštine* (PhD thesis), UVJ, Beograd, 1993, p. 110-117; VIŠNJIĆ, Dušan, KOVAČ, Mitar, MARČEK, Jan, *Naučna ishodišta vojne doktrine*, paper in: Vojna nauka, Zbornik radova, Tekom Graf, Belgrade, 1998, p. 525-554.

13 Lat. *doctrina* means: "... learning about something exposed as a system." VUJAKLIJA, Milan, *Leksikon stranih reči i izraza*, Prosveta, Belgrade, 1980, p. 273); "... collection of views of a science... " (*Popularna enciklopedija*, BIGZ, BBelgrade, 1976, p. 256).

14 SAKAN, Momčilo, *Vojne nauke*, Military Academy, Belgrade, 2003, p. 53.
"Doctrine are statements that formulate the norms of practical activities in a particular experiential area" (MARKOVIĆ, Mihailo, *Filozofski osnovi nauke*, SANU, Beograd, 1981, p. 16).

doctrine as their constituent.[15] Due to the neglect of this fact, in practice doctrine is often equated with science, which makes a major logical error.

Doctrine cannot be equated with science. Science and doctrine are various types of human knowledge, and therefore there are important differences in the approach to certain problems of reality, generality and relationships to actual practice. Science is trying to find out the essence of the problem of objective reality, and therefore the reality itself, while the doctrine strives for guidelines and norms of practical activities to address the problems based on the essence of objective reality. Based on this, we can say that science tends to determine the objective truth about the reality of general social significance, and doctrine tends to connect exposure that has direct practical significance. Doctrine answers the question of "how" to solve practical problems in a particular field, and science provides the answer to the question "why" the problem has to be solved in the exact way. The doctrine has the power of authority, as the approved and verified material is binding on all members of the organization, but it does not have a theoretical capacity, because such a characteristic takes away the aspect of the approach to the problems. If, contrary to its real essence, the doctrine were added and artificially imposed theoretical power, that is, it were declared a scientific theory, then everyone would have to admit it as the scientific field. Who would dare to challenge the scientific reliability of such a document when the highest authority is behind it? This would cause such a scientific field to lose one of its most important characteristics, methodical suspicion of the veracity and viability of each statement.[16] In this way, a proclamation of the doctrine as a science would lead to the dogmatization of its views and blocking research efforts. Science does not have the power of authority as doctrine but has a theoretical capacity. Science contributes to learning about the empirical facts, individual knowledge of reality whose authenticity was verified and confirmed by practice. These facts are adopted and incorporated into doctrine after their scientific verification. Thus, doctrine does not criticize the current situation but opens the perspectives of practice and indicates those elements that are known and verified, and what has not been proven is kept in the theory of science and proved. Similarly, the doctrine cannot define all terms perfectly, because in scientific

15 VIŠNJIĆ, Dušan, *Kako misliti doktrinu* (članak), "Vojno delo", br. 1/1995, NIU "Vojska", Beograd, p. 35.

16 RADINOVIĆ, Radovan, *Metoda ratne veštine*, VIZ, Belgrade, 1983, p. 170.

terms, it is the domain of the theory of science. Descriptive definitions are sufficient for doctrine; however, key words must be completely understandable, which will enable the unambiguous understanding of their meaning, content and scope.

The doctrine is the extract[17], result or product of applied science, that is, its theory. It is an instruction aimed at the subjects of a specific area of human activity. It is written in the form of a directive, and its views are brisk, concise and economical to the maximum extent, meaningfully connected and not contradictory. The focus of the doctrine on the subjects in different areas of reality allows its system structure. Based on that, within the doctrine of a particular state, specific doctrines can be extracted, such as diplomatic, political, economic, legal, military, educational, confessional, etc. Each of them is then structured to individual doctrines. In science, there are all kinds of doctrine, and the evidence presented above shows that the state chooses only one of them – the one that best suits the national interest in the circumstances.

Thus, the doctrine is a set of management principles aimed at the subjects of specific areas of human activity, but it is also a guide for practical activity of people in certain conditions. However, the guide must not be a dogma – we have already pointed out where it would lead, but it changes according to the general situation in the country and its environment. The doctrine, if military, should as a guide be subject to change and be constantly updated and adapted to the defense needs of the people.

Based on the above definitions, it can be concluded that the doctrine is "a reliable view based on realistic and scientific knowledge on all issues concerning a certain human activity; the view which has immediate practical significance".[18] This definition of doctrine directly imposes specification of the terms *military doctrine* and *doctrine of Operational Art*.

We have already pointed out that doctrine has a system structure made up of specific doctrines that are its integral parts. Consequently, military doctrine, and all others, constitutes an integral part of the state doctrine. At the same time, it is one of the constituents of the Defense Sciences and is a direct connection between the theory and practice of planning, preparation and execution of combat operations.

17 Ibid, p. 170.

18 LIPTAI, Stevan, *Teorijska izgrađenost taktike* (Master thesis), CVŠ VJ, Belgrade, 1996, p. 176.

Like all others, the military doctrine has its point of origin and subject. In the literature, there are different understandings of the point of origin of military doctrine. This inconsistency about understanding the point of origin[19] of the military doctrine is probably due to the undefined concept of the *point of origin of the military doctrine*, as well as its relationship to other concepts in the science of defense and military activity in general. For this occasion, the most acceptable definition is that the points of origin of the military doctrine are "starting points, footholds and basic ideas underlying supreme rules of the military actions of the state and its military in peace and war".[20] The points of origin of the military doctrine can be divided into scientific and social ones.

Scientific points of origin of the military doctrine are located directly – in the constituents of the Defense Sciences and indirectly – in the scientific achievements of other sciences and scientific disciplines.[21]

The immediate scientific points of origin of the military doctrine are the Defense Sciences and all constituents of Defense Sciences. It is important to see the actual connections of military doctrine with each of them. Defense Sciences as the point of origin of military doctrine have an impact on its content in accordance with the objectives and criteria formulated by the state authorities, or to offer optimal solutions in certain circumstances for problems related to armed struggle and military practice. Therefore, conditionally, it can be said that Defense Sciences affect "technological"[22] and not "political" aspects of military doctrine. Setting objectives and criteria is the responsibility of the state, and is often called its "political" aspect and the technological part is called "technical" aspect of

19 "Point of origin is a starting point, the place, the situation where the outcomes starts, beginning, start" (*Rečnik srpskohrvatskog književnog jezika*, book five, Matica srpska, Novi Sad, 1967, p. 996).

20 VIŠNJIĆ, Dušan, KOVAČ, Mitar, MARČEK, Jan, *Naučna ishodišta vojne doktrine*, paper in: Vojna nauka, Zbornik radova, Tekom Graf, Belgrade, 1998, p. 529.

21 Read more about scientific points of origin of military doctrine in: VIŠNJIĆ, Dušan, KOVAČ, Mitar, MARČEK, Jan, *Naučna ishodišta vojne doktrine*, paper in: Vojna nauka, Zbornik radova, Tekom Graf, Belgrade, 1998, p. 525-554.

22 According to Soviet sources, "the military doctrine has two aspects: political and technical. Political aspect relates to the political assessment of the character of military tasks of the state, technical answers to the questions that arise in connection with the already drawn or perceived characteristics of an armed conflict in a future war. They determine military-technical tasks of the armed forces, means and methods of armed combat in relation to technical capabilities" (Group of authors, *O sovjetskoj vojnoj nauci*, VIZ, Belgrade, 1966, p. 398).

military doctrine. The importance of Defense Sciences for military doctrine is reflected in the results achieved in this area, as well as the readiness of personnel who participate in the development of military doctrine, to take into account the results of scientific research. If the personnel does not respect the results obtained in the Defense Sciences, it inevitably leads to subjectivism. "Subjective military doctrines" throughout history have proved to be wrong, because they were not adapted to the practice of armed struggle in the future. Therefore, any artificial gap between science (Defense Sciences) and profession (science and art of war) causes a negative impact on military effectiveness in combat. If Defense Sciences in their development lag behind Defense Sciences in the world, military doctrine will inevitably fall behind in the "technological" aspect (organization, management, planning, preparation, engagement, security, etc.). Because of this, small countries, such as ours, must aim to achieve the benefits in the development of Defense Sciences as the points of origin of military doctrine and military skill, as well. The advantage will to a certain extent compensate for inferiority in the domain of other starting points (technology, economics, and the like).

As for the constituents of the Defense Sciences, it is reasonable to start from the premise that there are different effects of certain constituents on the formulation of doctrinal views. In this, it is important to perceive actual connections of military doctrine between each of them. The *language of the military doctrine*, as the first starting point, is based on the standard literary language in general and in the language of Defense Sciences in particular. Unlike the language of Defense Sciences, the language of military doctrine is the language of standard. The language of military doctrine is often identified with the language of Defense Sciences, as a result of insufficient differentiation between scientific and doctrinal language. Language of the military doctrine is based on the language of Defense Sciences, that is, it is derived from the language of Defense Sciences, with the fact that every science insufficiently developed in its linguistic fund has mainly doctrinal language (language practice), as is the case with Defense Sciences. The purpose of the language of military doctrine is not to mark the subject of study, polemic discussion, rethinking, proving, explaining, and the like, but the clear and unequivocal expression of specific practical actions of members of the military and other subjects in armed conflicts. The language of military doctrine is primarily descriptive and pragmatic with clear and unambiguous statements, but it can also use explanatory improved definitions of the basic concepts of Defense

Sciences. Additionally, the language of military doctrine should be flexible enough to include in its lexical fund new scientifically verified concepts engendered by Defense Sciences.

Other points of origin include *empirical facts* in the field of armed conflict. They represent the individual knowledge of reality whose authenticity has been verified and confirmed in practice and they are adopted and incorporated into military doctrine only after their scientific verification. A lack of scientific testing of empirical data can lead to pragmatism, that is, those facts are not a reliable basis for predicting future events, because the projection of the future is based on what has already been experienced. Therefore, they must first become scientific facts and then incorporated into military doctrine.

The third scientific point of origin are *laws, formulas, ideal patterns and ideal types* for now, with no significant differences between Defense Sciences and military doctrine, because the Defense Sciences and their disciplines are still at an unsatisfactory level of scientific development. In Defense Sciences this problem is even more pronounced, given that so far it has not identified and scientifically verified the laws in armed conflict, although attempts have been made.

The fourth scientific point of origin includes *methodological rules*, that is, methodology with all the characteristics of its scientific development discussed. The current methodological knowledge is modest in terms of identifying methods and methodology of development of military doctrine, though there are scholars who believe that the method of military doctrine stems from the method of Defense Sciences, with the only difference being that the general principles and basic elements of the method (methodological approach, logical-epistemological part and scientific-technical part) are specified and concretized according to the subject of military doctrine.[23] Solving this problem would contribute to a more comprehensive examination of the general relation of Defense Science – military doctrine and reliable theoretical and methodological basis for the development of military doctrine would be built, with respect to the starting points determining it.

The fifth point of origin – *statements* establishes the immediate, closest and most important relationship with the military doctrine. They formulate the norms of

23 SAKAN, Momčilo, *Vojne nauke*, Military Academy, Belgrade, 2003, p. 56.

practical activities, design doctrines of potential opponents and allies. Other constituents of Defense Sciences also have a similar role of direct scientific points of origins.

Indirect scientific points of origin of military doctrine are the achievements of all other sciences, which affect the establishment of standards of practical activities. Among them, the achievements of social, political, economic, technological, natural and mathematical, historical, medical, pedagogical and psychological sciences are particularly significant.

The social points of origin of military doctrine are: (1) state and national interests and objectives, (2) state doctrine, (3) geopolitical position of the state, (4) economic power and potential of the state, (5) technical and technological development, (6) demographic factor, (7) the state of the military, (8) educational system, (9) political system, (10) legal system, (11) traditions of the people and the state, (12) military alliance, (13) signed international agreements and treaties, charters, resolutions and other documents of international bodies, organizations and communities, (14) military doctrines of coalitions, great powers, neighboring countries and the like.[24] These points of origin are very important, since specificities of the military doctrine directly stems from them. Unlike science, doctrine is not universal. "Military doctrine applies to one side, one country and its military and, as such, must be adapted to the particular social conditions in which the state and its military are"[25] regardless of the universal models of various doctrines in the theory of science.

Analyzing the subject of Defense Science, there is a need to explore its relation to the content and scope of military doctrine, which would resolve the methodological problem of the difference between military doctrine and Defense Science and its disciplines. The subject of military doctrine stems from the subject Defense Science. The main difference between them is that the subject of Defense Science is armed conflicts – armed combat and battle, with no particular examples of events and the subject of doctrine is a particular case of armed conflict. These

24 Details about this can be seen in: STIŠOVIĆ, Milinko, *Društvena ishodišta vojne doktrine*, paper in: Vojna nauka i vojna doktrina, Zbornik radova, Tekom Graf, Belgrade, 1998, p. 425-447.

25 SAKAN, Momčilo, *Vojne nauke*, Military Academy, Belgrade, 2003, p. 57.

are armed conflicts which may be initiated by a state or may be imposed upon the state. Each country can participate in the potential or actual armed conflicts. Participation in potential armed conflicts is practiced through various forms of applied training of commands, commanders, units and other entities, such as maneuvers, tactical exercises, command and staff war exercises and the like, and also in real conflicts – when they actually occur (either initiated or imposed). This involvement of the state in armed conflicts determines its uniqueness and is different from armed conflicts in general, because it applies to a particular state, its space, its armed forces, weapons, equipment, environment and the like. Therefore, armed conflicts in which the state would participate are not abstract. They are concrete and have their subjects to be considered. Otherwise, a lack of specific subjects leads to a disorientation and degradation of the practice the doctrine is related to.[26]

Based on the above definition, it can be concluded that military doctrine is an integral part of state doctrine and that it is a "realistic, scientifically based, exposed view of all the fundamental issues of military activity that has immediate practical importance in the field of the special case of the manifestation of armed conflict in which the state (its military) participates".[27] The initial definition of the military doctrine raises the question of its relation to the substance of the term doctrine of Operational Art and the doctrine (doctrinal provisions) of Operational Art itself.

The doctrine of Operational Art is an integral part of military doctrine and therefore contains all previously mentioned characteristics of the term *doctrine* and *military doctrine*. The doctrine of Operational Art is one of the constituents of Operational Art. It is both its product and ultimate goal. The doctrine of Operational Art provides guidance for practicing the (operational) combat actions within an operation. Its doctrinal positions are current for the leaders of (operational) combat actions, but also for other entities of particular military force that exhibit practical activity in the area of operations.

Points of origin of the doctrine of Operational Art and the military doctrine can be grouped under the scientific and social categories. The scientific would

26 Ibid, p. 55-56.

27 LIPTAI, Stevan, *Teorijska izgrađenost taktike* (Master thesis), CVŠ VJ, Belgrade, 1996, p. 177-178.

directly include all scientific constituents of Operational Art and, indirectly, all the achievements of different scientific fields that are applied in the field of Operational Art. Social points of origin of doctrinal provisions of Operational Art, except for the level of impact, are not different from the social points of origin of the military doctrine.

The subject of the doctrine of Operational Art is operation, in which at least one side is known (the subject the doctrine of Operational Art relates to), while the other side is invariantly modeled, as a concrete or an abstract entity, including all the problems of man's military professional activity in the operation. In this way, the doctrine of Operational Art becomes the basic orientation for their practical solution. With respect to this, the initial provision of the doctrine of Operational Art can be given.

The doctrine of Operational Art is an integral part of military doctrine and a realistic, scientifically based, exposed view of all the fundamental issues of the practical activity of tactical and operational units in a particular case of an operation in which the specified subjects are involved. Doctrinal provisions of Operational Art are linked in a single system of management principles, meaningfully related and non-contradictory. As part of military doctrine, the doctrine of Operational Art is connected and aligned with the doctrines of Tactics and Strategy.

The doctrines of Defense Sciences are related as general, special and individual. This relationship implies subordination between the provisions of certain doctrines and mutual compatibility. The doctrine of Strategy deals with the problems of the highest military values and, in this sense, programs general guidelines, while the doctrine of Operational Art programs specific guidelines of practical combat (tactical) activities. Doctrinal provisions of Tactics are carried out, in relation to these guidelines, as individual tactical instructions and rules, and they are most concretely connected with the practice of combat operations. Doctrinal provisions of Operational Art, in addition to serving as guidelines for Tactics (for tactical activities) are related and at the same time harmonized with the technological part of military doctrine, that is, the combat systems used, the possibilities of branches in the field of operational units, the training system, combat (order) layout and operating procedures. In other words, the doctrinal system of Operational Art can refer to each of the elements of Operational Art,

having been previously agreed with the system of other doctrinal provisions in the Defense Sciences.

Accordingly, retroactive action of the doctrine of Tactics to the doctrine of Operational Art and Strategy should not be neglected, either. Many of doctrinal provisions of Operational Art are derived by induction from the doctrinal provisions of Tactics. Operational Art as a higher level of generality should take into account the specific features of the individual provisions of the practice. Thus, the determination of the front size and depth of attack (defense zone) of brigades and higher units arose from the front (depth) of attack (defense zone) of basic modular units down to the individual.

Defining the essence of the concept of the doctrine of Operational Art has created conditions for the specific consideration of its relationship with the theory of Operational Art, which is especially important for the significance and pragmatism of the theory of Operational Art.

The Explication of the Relationship Between Theory and Doctrine of Operational Art

The difference between the concepts of *doctrine* and *science* has been emphasized in the previous considerations and it means that it is necessary to notice a difference between scientific theory and doctrine. Numerous military theorists have dealt with this issue from the very beginning of the theory of defense (Military Sciences), although not explicitly enough. One of them is Clausewitz, who claims that "... the theory should be mere consideration, but never a rule".[28] In order to notice the difference between scientific theory and the doctrine of Operational Art, we will emphasize several postulate attitudes regarding their relationship, thus enabling the high-quality identification of it, but with no illusion that this paper can notice and identify all their relations.

28 KLAUZEVIC, K., F., *O ratu*, Vuk Karadžić, Belgrade, 1951, p. 105.

1) The scientific theory of Operational Art is directed to the understanding of the reality of operation and doctrine of Operational Art is based on understanding or, in other words, on knowledge relating to scientific theory. It means that the scientific theory of Operational Art, in relation to doctrine, is the starting point and re-destination, bearing in mind that the doctrine of Operational Art also becomes theory, though not a scientific one but theory in a wider meaning.
2) The scientific theory of Operational Art contributes to the improvement of human practice (combat activities in this case) through the genuine understanding of the reality of combat/armed struggle, in such a way that the already obtained scientific discoveries enable the creation of pragmatic and doctrinal instructions which will regulate the practice of people in the field of Operational Art based on the progress of its scientific theory.
3) The scientific theory of Operational Art seeks to understand operations as a subject in general, without the concrete event which takes place, while doctrine deals with concrete cases of operations that really happen.
4) The scientific theory of Operational Art is a universal one, meaning that it has – or at least should have an international character, with the contents composed of scientifically verified and experienced facts (scientific facts) about an operation, i.e., individual facts about reality, the truthfulness of which has already been checked and confirmed in practice. Unlike scientific theory, a doctrine of Operational Art does not have an international character but it has a national, state character and its contents includes the instructions and regulations for acting in the field of operations in which the state and its army are going to take part. The Doctrine of Operational Art must not be "subjective" because that necessarily causes negative consequences in the efficiency and effectiveness of the units (therefore the army itself) in the operations. "Subjective doctrines" have proved to be wrong thorough history, because they have not been adjusted to the practice of armed struggle (therefore the operation itself) which take place in future.
5) The scientific theory of Operational Art is science-based, but less than necessary. It studies the experiences in the field of (military) operations, describes and classifies them, explains and foresees the essence of the subject and process in the reality of the operation. It provides regulations for the practice of people involved in the field of operation, formulating itself as a program for some future practice.

6) The scientific theory of Operational Art is critical and methodologically obtained knowledge, while a doctrine of Operational Art is a group of binding attitudes backed by the authorities (army, state...).[29]
7) The scientific theory of Operational Art is more stable than a doctrine of Operational Art due to more intensive changes in the social outcomes. A doctrine of Operational Art must not be a dogma but, in accordance with the intensity and volume of the changes in the social and scientific outcomes, it should be gradually redefined or, if necessary, completely changed.

A doctrine of Operational Art is an extract, product and result of the knowledge about the theory of Operational Art. It connects theory and practice, meaning that through the doctrine, theory applies its achievements in practice; in that way the doctrine directs the future practice. However, the relation between them is not with one meaning only, because practice in the reverse direction establishes truthfulness of the theory by either confirming or rejecting the correctness of the doctrinaire attitudes derived from theory (Figure 1). In that way the doctrine of Operational Art brings the theory of Operational Art and its own contents into the position of "development". Unconfirmed doctrinaire attitudes of Operational Art require the changing of the elements of the theory of Operational Art that they are based on. It is the trinity of theory, doctrine and practice in which Operational Art is being developed as a unique entity.

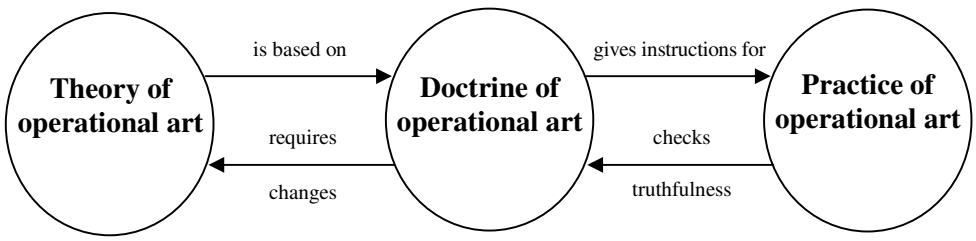

Figure 1. Relationship among theory, doctrine and Operational Art practice

29 According to Russian sources, "military doctrine, after being adopted and introduced in practice, acquires character of a state law" (Grupa autora, *O sovjetskoj vojnoj nauci*, VIZ, Beograd, 1966, p. 399).

The scientific building of the theory of Operational Art provides conditions for the subjects participating in the operation to consider and understand their place and role in the operation in a more adequate way, as well as the actual essence of the phenomenon. Based on that, they can foresee future activities in the phenomenon and prospectively shape its reality. In such a relationship the theory of Operational Art reflexively acts on the doctrine of Operational Art and its practice.[30] It establishes the pragmatic activities of the subjects involved in the practice of Operational Art in a scientific and cognitive way. At the same time, the theory of Operational Art prevents the direct application of empirical experience in the building of the doctrinaire attitudes. Prior to having direct influence upon new doctrinaire attitudes, the empirical facts must pass scientific verification through methodological apparatus of Operational Art and the art of war.

Contemporary theory of Operational Art, fragmented within the national frameworks, is often characterized by doctrinaire features. This situation is the result of a strong material and financial component as well as of the positivist and pragmatic influence of financially powerful countries. Due to their material and financial component and without specific theoretical foundation, the great powers make experiments with certain doctrinal solutions. In that way and for pragmatic reasons, Operational Art is directly guided by national doctrine. Results of scientific work (scientific theory) are not taken into consideration, thus degenerating the theory of Operational Art and equating it with doctrine. Doctrinal attitudes, often subjectively based on the will of few people in the military (who, in most cases, are not directly involved in science and who do not respect the results of research in Defense Sciences), are used as a starting point for the orientation of the elements of organization, combat disposition and acts in Operational Art (operation).

Unlike the great powers, smaller countries which are characterized by the doctrinal features of the theory of Operational Art, do not have strong material support for experiments in the field of Operational Art, and this is primarily seen in the actual reality of an operation. Instead of trying to get advantages in the development of the scientific theory of Operational Art as the origin and outcome

30 ŠULJAGIĆ, Radosav, *Teorija ratne veštine – naučna izgrađenost teorije jugoslovenske ratne veštine* (PhD thesis), UVJ, Belgrade, 1993, p. 110-117.

of the Operational Art doctrine, it often happens that the authoritativeness of their doctrine of Operational Art dominates and does not respect the changed reality of the operation. Such a doctrine is an impediment to the development of any theoretical thinking on Operational Art. It is proclaimed to be dogma and any kind of discussion on that issue is understood as speculation and untruth. While "in power", such a doctrine eliminates the possibility of any theoretical and cognitive activity. Testing it in practice results in negative consequences upon the efficiency of an army in armed combat (operation), as well as in enormous human and material losses. The above mentioned attitudes impose the question of the views of the Operational Art theorists concerning their doctrine.

Operational Art theorists have an obligation to follow the doctrinal rules and regulations of Operational Art in its expert realization, with the possibility to find valid solutions to the problems which the practice of Operational Art faces nowadays and will face in the future. In this way they show flexibility, thus affirming a critical approach to the doctrinal rules and regulations. In such a relationship and in accordance with the intensity and extent of the applications in social and scientific origins and outcomes, the doctrine of Operational Art is either gradually redefined or completely changed.

The theory and doctrine of Operational Art are in a constant relationship of two-way interaction – doctrine is closer to practice and it has a transfer role of the influence of theory upon practice and vice versa. The relationship between theory and doctrine of Operational Art is actualized in that respect.

Conclusion

Based on the general considerations it can be concluded that theory at the same time represents reflective cognitive activity by means of which it is possible to gain certain knowledge about a respective field of reality as well as the very knowledge about the objects or processes in that reality which are the final result of the activity. The term *theory* can be understood on different levels of generality. One of the possibilities is to understand it like a so-called theory in a wider sense (generally) and theory in a more precise sense. Theory in a wider sense refers to any reflective cognitive activity and any knowledge through which a respective

realm of reality is to be understood. It incorporates both unscientific and scientific knowledge. Unlike this, theory in a more precise sense has a scientific character and can be considered in the form of the theory of science and scientific theory. It is much better systematized, more objective and it has a critical approach. Basically, it is being built with respect to a strictly defined and exact principle of methodology of science.

Doctrine is the consequence or product of an applied science, that is, of its theory. It represents an instruction directed towards subjects of certain field of human activity, but it is in the same time an instruction for the practical activity of people in certain conditions. Its being directed to the subjects in various fields of reality provides it with a systematic structure. Based on that and within the doctrine of the very country, special doctrines can be distinguished, such as: diplomatic, political, economic, legal, military, educational, confessional etc. Each of them is separately structured into individual doctrines. Accordingly, military doctrine is an integral part of the state doctrine and it a represents realistic, science based, logically connected attitude concerning all basic issues of directly and practically important military activities in the field of a specific case of combat struggle in which the country (its army) takes part. At the same time, it is one of the constituents of Defense Sciences (Military Sciences) and it represents the direct connection between the theory and practice of preparation and the conducting of combat activities. It stems from the initial definition of military doctrine and an instruction for its practicing in combat activities within an operation. The doctrine of Operational Art is, or it should at least be, a logical consequence – a product of the knowledge concerning the theory of Operational Art. As such it directly guides the future practical activity of people in the domain of operation and thus the very practice. Confirming of the inadequacy of the doctrinal attitudes also initiates a changing of the elements of the scientific theory of Operational Art structure due to the new conditions in which the operation is conducted. Change to the Operational Art theory retroactively influences upon the creation of new doctrinal regulations. Today the doctrine of Operational Art is to a small extent a scientifically based constituent of Operational Art with the tendency to be more scientifically based in the future and, in a mutual relationship with theory and practice, it will provide for the development of Operational Art.

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STRATEGIC SHIFTS AND THEIR IMPLICATION FOR MODERN SECURITY

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Abstract

In terms of strategic developments on the international arena, recent years were characterized by a series of strategic changes: the Washington administration declared the US intention to shift its military effort towards the Asia-Pacific region, in order to further maintain its global strategic superiority. This intention was based on the perception of increasing Chinese military capabilities in the region, and economic ones at the global level; China continued to strengthen its economic position at the global level, simultaneously with the identification of new energy resources, Russia reformed its military forces and France reaffirmed its traditional position in Africa.

Key words: strategic shift; security; France; Russia; US; EU, resources competition, military power.

In the last thirty years global security has been transformed by a series of major events: the end of the Cold War, the dissolution of the USSR, terrorist attacks on the US in 2001 and the financial and economic crisis in the 2008-2010 period. Every major event lead to strategic shifts that fundamentally redrew the global political, economic and military map.

The term "*strategic shift*" is used in our paper in the sense of strategic changes needed to be made in order to achieve a certain vision, the strategic change being

defined as an alteration in an actor's alignment with its external environment[1], without affecting its national strategic interest.

Starting from the theoretical state concept we could create the layout of relationships amidst sovereignty, the core values of national identity and national interest. The schematic layout is illustrated in *figure no. 1*; its conceptual core being extracted from the fundamentals of the general theory of law and public international law, adding elements of the relationship created between the security, strategy, and geopolitics.

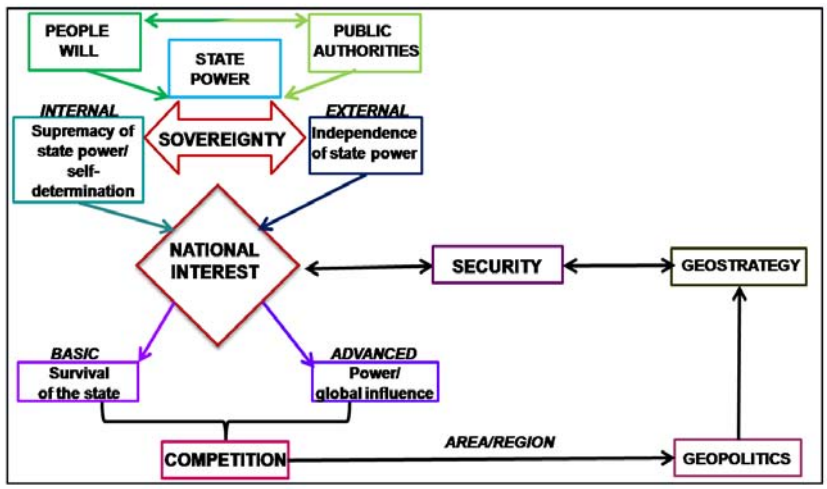

Figure 1. Relations amidst state power, strategy, national interest and security[2]

Following the logic of the schematic layout any strategy for national security of the state must be related to the desired role to play in the modern world. This way, in order to protect its interests at home, any state must project its influence abroad. Thus, it is required of the economy of that state to be able to compete with the strongest regional or global economies. However, the protection of national

1 Rajagopalan N. and Spretzer G.M, "Toward a theory of strategic change: a multi-lens perspective and integrative framework", Academy of Management Review, Vol. 22, No.1, pp.48-79., 1996, Van De Ven A. H & Poole M. S. (1995), "Explaining Development and Change in Organizations", Academy of Management Review, vol. 20, No. 3, pp. 510-540. 1995.

2 Design by the author from a concept adapted from Nicolae Popa, Mihail Constantin Eremia, Dragnea Daniel Mihai, Teoria generala a dreptului, Editura C.H. Beck, București, 2005.

interest by projecting influence abroad must be extended beyond the realm of economic activities, enforcing it with the military means.

A major role in achieving every state strategic interest is the grand strategy, perceived as the relation of means to large ends, where the large ends can be represented by the long term security of some state or nation etc. Since Clausewitz, the definition of strategy has been formulated in various ways, every time as a strict image of the author's contemporary realities. Thus, whereas Clausewitz saw strategy as the employment of battles to gain the end of war, Liddell Hart proposed a slightly different approach, considering strategy as being the art of distributing and applying military means to fulfill the ends of policy.

Considering the Liddell Hart approach as a one that serves the purpose of our paper, we will focus our analysis on the strategic shift which emerged after the financial and economic crisis. In the context of the situation created by the crisis, major international state actors concentrate their efforts in order to gain access to or to consolidate their position in regions that have large energy resources. Thus, the main strategic events took place in regions of North Africa and the Middle East, but we believe that they are part of a broader strategic influence expansion of the great powers in order to provide control over the Caucasus region, Central Asia, Middle East and North Africa; regions which contain most of the world's energy reserves and, moreover, host the terrestrial and marine transport routes needed to reach their consumers. It is easy to see that those regions that correspond to the strategic areas that, back in the year 1904, Halford Mackinder and Nicholas Spykman called Heartland (*Figure no. 2*).

Considering the above logic and theories, we think that the strategic evolution of the main international actors was developed in order to enlarge their spheres of influence so as to achieve and maintain control in regions hosting the greatest energy reserves, most of them being located in Asia.

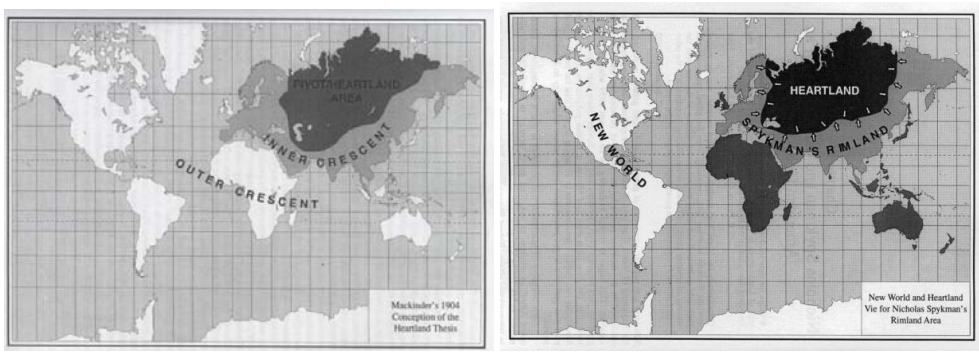

Figure 2. Graphical representation of the theories of Halford Mackinder and Nicholas Spykman

Strategic Shift Impulse(s)

Prior to the current financial and economic crisis there was strong evidence that the global landscape of political and financial structures, dominated by United States and Europe, was about to change. Asia recorded an economic resurgence and cumulative financial strengths succeeding in overshadowing the US and Europe in terms of economic and financial strength.

Aware of this economic global shift to Asia and considering the rise of Russia and China, beyond the economic issues, as military powers in the region, the US decided at the beginning of 2012 to direct a strategic pivot position to the Asia-Pacific by relocating its forces from Europe and reducing ones in the Middle East. The U.S. planed to transfer its major strategic effort from the Atlantic to the Pacific on the basis of the strengthened positions of China and Russia in the region; a China which has been continuing its race to accumulate energy resources, while in the mean time transforming its army and military equipment. Simultaneously Russia, based on financial resources gained from the exploitation of natural energy resources and rare metal provided by its national territory, has been strengthening its dominant position compared to both the European countries and to US.

Most of the international relations scholars agreed that the US decision was of great importance for the international security environment, with implications ranging from Africa to Japan.

We consider that US major strategic shift was preceded by a prior series of strategic changes, namely: *the rise of Russia and the transformation of its military forces; the rise of China and its extended influence in Africa; and the Arab Spring, Libyan war and the position of France and NATO with the background of financial and economic crisis.*

Russia – economic and military reforms through energy leverages

NATO enlargement towards the East was perceived by Russia as an attempt to weaken its dominant position in Eurasia, which led to a strengthening of its relations with former Soviet states by creating regional collaboration instruments that attracted other regional powers, like China and India. In the last decade, backed up by its vast energetic resources, Russia's dominant position has been strengthened by military cooperation initiatives in the Central Asia region, mainly to counterbalance NATO enlargement towards a region placed in Russia's traditional area of influence. Transformation of the security environment and the need to adapt its responses to new threats lead to the necessity to reform the Russian Armed forces. Thus, issuing its Military Strategy in 2010, Russia accelerated the reform process. With an extensive military experience inherited from the Cold War Era, Russia still possesses a significant amount of forces and military equipment.

The armed forces reform process will not aim only at quantitative transformation, at the size level, but at a qualitative, structural one, matching the traits of the contemporaneous security environment. The armed forces will be resized to the amount of 1 million, an NCO professional corps will be created and the control and command system will be improved[3]. The Russian army will move from the military district-division-company structure to the military district-brigade-company; there are two reasons standing behind this decision:

3 ***, Rossiiskaya Gazeta, 15 Octomber 2008.

- necessity to improve the response to the new security environment challenges, under former circumstances a division was too large a unit, hardly suited to contemporary armed conflicts;
- the optimization of command and control system through the avoidance of the redundant elements.

Implementing this plan of reform in a period of global economic crisis was considered rather hazardous when we have in mind the fact that, prior to crisis period, the trends of Russian military spending, compared with the US military spending were decreasing. It seems that Russia relies though on its energy resources, which translated into financial resources, which, in turn, could provide the necessary amount in order to modernize its army.

The reformation plan seemed to be a larger one, Russian authorities recently expressing their expectation to become one of the top five military forces of the world. In this respect, 70% of the military equipment will be replaced with modern equipment by the year 2020. Statements on military modernization projects also indicate increased efforts in order to develop strategic forces, the fabrication of new nuclear strategic weapons and 100 ships for the navy.[4]. According to the same sources, Russia wants to purchase military equipment produced by NATO Member States, for the first time in its recent history: French Mistral helicopters, amphibious class assault ships and 5th generation PAK-FA combat aircraft, also produced by France.

The issue regarding the modernization of nuclear strategic forces[5] is grounded on two main reasons: on the one hand it is the emplacements of the missile defense system in Europe which are located in close proximity to Russia's borders, and on the other hand, a compulsory stage in meeting the *New-START* treaty on reducing nuclear weapons, signed with the US. According to the treaty, Russia's nuclear strategic forces have to be reduced by one third.

As previously mentioned, NATO enlargement towards the East in conjunction with the US intention to place missile defense system elements on the territory of

4 Ria Novosti, http://rt.com/news/military-budget-russia-2020.
5 *Russia to invest $100 bln in defense industry until 2020*, Ria Novosti, 21 March 2011.

NATO Member States in Europe, has prompted a more vigorous Russian foreign policy and the development of its own missile defense system.

Although the NATO Summit in Lisbon lead to reconciliation between NATO and Russia[6] (improving US and Russia relations), some disagreements were revealed, especially on the missile defense system issue. Despite the Russian proposition to establish a common NATO-Russia missile defense system, the participants becoming equal partners, after the Honolulu meeting on 12 November 2011, Dmitry Medvedev announced that US and Russia have different views on the missile defense issue. Moreover, during a meeting with the officers from South Military District, which took place in Vladikavkaz, the former Russian president stated that the reaction to the placing of a missile defense system in Europe will be reasonable and sufficient without blocking the dialogue with NATO. Thus, Dmitry Medvedev considered that Russia is preparing to answer in two ways: military and diplomatic. Russia could take military measures such as: the establishment of a radar station in the Kaliningrad Region, locating offensive missiles in the western and eastern side of the country, while improving the security of nuclear facilities. As to the diplomatic way, Russia could adopt cooperation and further negotiations on the missile defense issue, which basically means to cooperate with NATO Member States, or to refuse further development in reducing disarmament and to benefit from its right of withdrawal from the START treaty. Russia's withdrawal would mean the beginning of a new competition on ballistic missiles, placing the former Cold War combatant states into a new rearmament race.

The Rise of China

According to the Defense Strategic Guidance[7], the rising of China as a regional power in East Asia has the potential to directly affect the U.S. economy and security,

6 *La Russie accepte le projet de bouclier antimissile à condition d'y participer vraiment*, http://fr.euronews. net/2010/11/21/la-russie-accepte-le-projet-de-bouclier-antimissile-a-condition-d-y-participer.

7 ***, *Sustaining US Global Leadership: Priorities for 21st Century Defence*, Department of Defence, Washington D.C., 2012, p. 2.

especially due to China's growing military power, whose strategic intentions yet remain unclear and may cause tensions both regionally and internationally.

To these programmatic issues cited from U.S. defense documents, we must ad the military prestige ones, referring to China's military capabilities. Those issues could have been identified in 2011, at the beginning of the Libyan war, when China proved the advanced level of its military capabilities, as was the case with the withdrawing of Chinese citizens from the conflict area, using expeditionary operational capability involving a IL-76 aircraft. The IL-76 route, with the starting point at Diwopu International Airport in Urumqi (northwest of China) and destination point at Sabha (central-eastern part of Libya), an estimated distance between them of 9500-10500 km[8], was possible by refueling once on its way to Libya and two times returning to China.

Moreover, the extraction of Chinese citizens from Libya by air was accompanied by another premiere, in the maritime sector, when a Xuzhou missile frigate transited the Suez Canal from the Gulf of Aden (where was it assigned to conduct anti-piracy missions) to Tripoli, (Libya), covering a distance of more than 4500 km with about 2/3 of the supplied[9] fuel. Besides demonstrating that the authorities in Beijing are concerned about the fate of their overseas citizens threatened by the security crisis, China managed to gain political and military prestige, especially since now Chinese naval forces poses an aircraft carrier, a fact that may worry neighbouring countries like Japan regarding China's shipbuilding capacity, and therefore rising more concerns.

In this context, the U.S. intension to move its strategic efforts to the Asia-Pacific region is more than justified, especially since China's neighbouring countries[10] in the South China Sea have expressed their concerns about the expanding Chinese

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8 Andrew S. Erickson and Gabriel B. Collins, *The PLA Air Force's First Overseas Operational Deployment: Analysis of China's decision to deploy IL-76 transport aircraft to Libya*, China SignPost No.27, 2011, pp.1-2, la www.chinasignpost.com.

9 Andrew S. Erickson and Gabriel B. Collins, *Missile Frigate Xuzhou Transits Suez Canal, to Arrive off Libya ~Wednesday 2 March: China's first operational deployment to Mediterranean addresses Libya's evolving security situation*, China SignPost No.26, 2011, pp.2-3, la www.chinasignpost.com.

10 Bernhard Zand, *Stronger Chinese Navy Worries Neighbors and US*, Der Spiegel, 14.09.2012, la www.spiegel.de/international/world/strengthening-of-chinese-navy-sparks-worries-in-region-and-beyond-a-855622.html.

influence in the region on the connected with significant hydrocarbons reserves under the sea floor.

In the search for massive natural resources, China has increased trade with African countries, reaching in 2008 to a figure of $ 10 billion, becoming the second trade partner after the US. Two thirds of China's imports from Africa consist of oil, and the main suppliers are Angola, Congo-Brazzaville, Equatorial Guinea and Sudan.

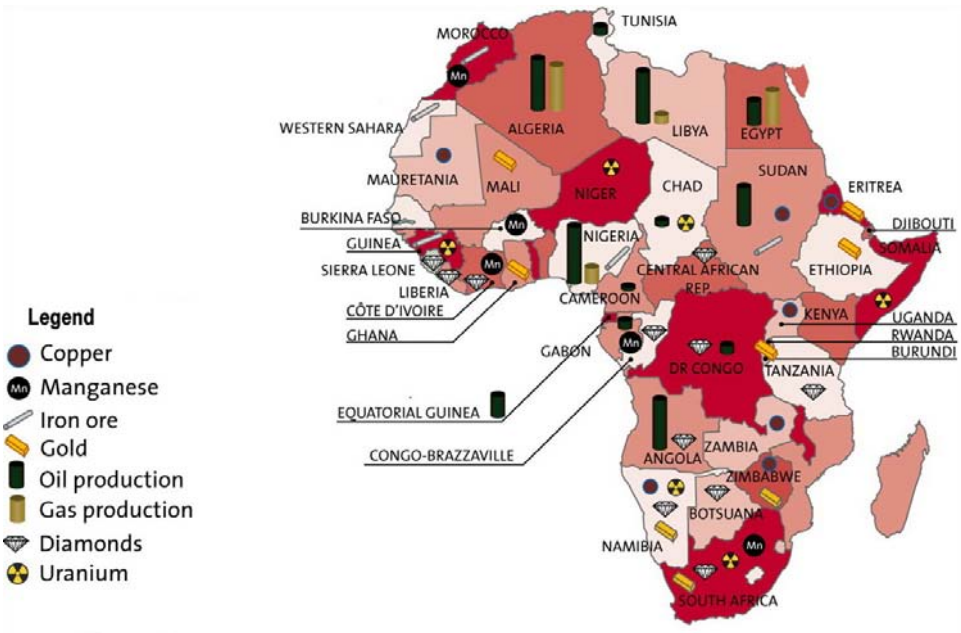

Figure 3. African continent's natural resources[11]

In exchange for energy and raw materials China provides assistance, trade agreements, the construction of critical infrastructure such as roads, railways and power plants. All this has made China an attractive partner for many African governments.

11 ***, *Strategic Trends 2010*, http://sta.ethz.ch/var/plain_site/storage/images/graphics/africa-s-resource-wealth-st-10/2345-5-eng-GB/Africa-s-resource-wealth-ST-10.jpg.

But China's actions have not passed unnoticed and have attracted the interest of other major powers like Japan and India which has resulted in the strengthening of the position of others on the continent, as in the case of the U.S. which showed that, similar with China, it is seeking to diversify energy sources to reduce dependence on the Middle East oil.

France and its interests in Africa

Viewed as a major event of 2011, the Arab Spring – as the series of popular revolts in North African and Middle Eastern states was generically named – benefited from world and regional state-actors' support, done in order to maintain a relative stability and not to further inflame an already tense situation that existed in these regions. While the US and NATO involvement may not have constituted a surprise in the case of Libyan military operations, for example, France on the other hand showed quite a pragmatic attitude. In this regard, France doubled its political statements with equal military efforts, its national contribution[12] to the international effort being surpassed only by those of the US. As resulted from the numerous analyses of the events, France's attitude was viewed as a surprise. A close look at the French defense papers, backed up by the fact that France is the most powerful economic and military state in the Mediterranean Area, an area in which by historical tradition, France exercised a certain control over the North and Central African states, benefiting from a large number of forces stationed in several countries on the African continent (Figure. no. 4).

Focusing on the economic and military dimensions, we must note that France is the second greatest European economic power, after Germany, and the fifth one at a global level. Moreover, France is the biggest and most powerful military force in EU and from the perspective of military expenditure; it is placed on the third place at a global level, as well as in the nuclear power where it stands after USA and Russia.

12 Daniel MÖCKLI, *Impartial and Stuck: NATO's Predicament in Libya*, CSS Analysis in Security Policy no. 91, Center for Security Studies (CSS), ETH Zurich, Aprili 2011, p. 3.

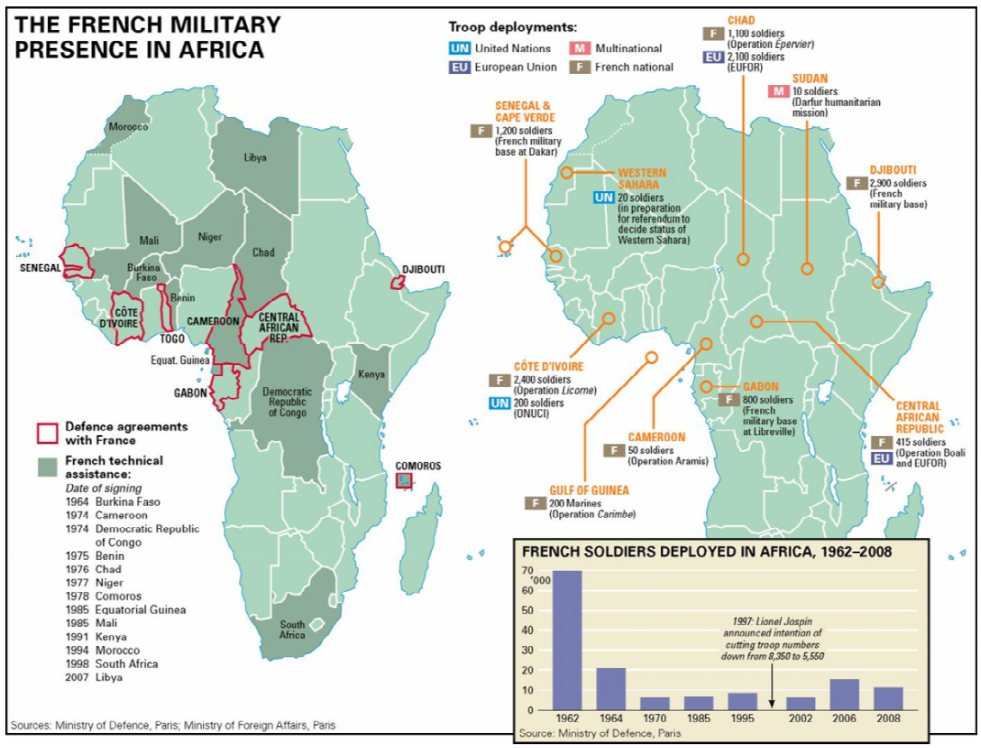

Figure 4. French military forces in Africa

As previously noted, most of the observers considered that France's involvement in the Libyan military operations was an opportunistic act. Despite these considerations, we believe that France has consistently pursued its national interests. This fact can be supported by the French White Paper on Defense and National Security, issued by the French government in 2008. According to it, there are four interest areas for France's security. We elaborate here on some of these regions' traits:

1. ***The Arc of Crisis,*** lies from the Atlantic to the Sea of Oman and Indian Ocean, from where France could expand its presence in Asia (and consequently to energy resources). In terms of stability and security, the area is characterized by some fields of concern, such as:
   - resurgence of radical Islam;
   - Sunni and Shi tensions;

- Kurd population;
- fragility of political regimes in the area

2. ***Sub-Saharan Africa,*** a region characterized by:
   - the abundance of strategic minerals and energy resources that need to be exploited;
   - population growth;
   - weakness of state structures;
   - poor governance;
   - migratory waves caused by economic and social tensions;
   - endemic wars (domestic and regional - Somalia, Congo, Darfur, etc..)
3. ***European continent and the relationship of European States with Russia*** are major priority issues for France. Russia and its policy on neighboring states, especially the former Soviet Union Member States remains a major European security issue, as well as the partnerships developed with other European states or with NATO.
4. ***North Africa, important for France for historical reasons*** (language, energy cooperation and economy) is already a competition arena for states like the US and China or terrorist organizations like Al Qaeda. The region is characterized by various risks: social inequalities, high unemployment rates, unequal development of the region, poor educational systems, increased illegal immigration, and high exposure to migrant's transit from sub-Saharan African region, social tensions and terrorism.

All previously mentioned regions are considered critical by France, because of their immediate vicinity to Mediterranean Area, the main argument being that Mediterranean security is in close relation[13] to European security. It is, in this way, that the main strategic axis[14] of French security is highlighted, an axis exposed to great risks (*Figure no. 5*), as it crosses the regions from the Atlantic to the Sea of Oman and the Indian Ocean. Moreover, these regions are the beneficiaries of several EU cooperation programs, as depicted in *Figure no. 6*.

13 *Defense et Securite nationale*, Le livre Blanc, Editura Odile Jacob/La documentation Francaise, Paris, 2008, p. 45.
14 Ibidem, p. 75.

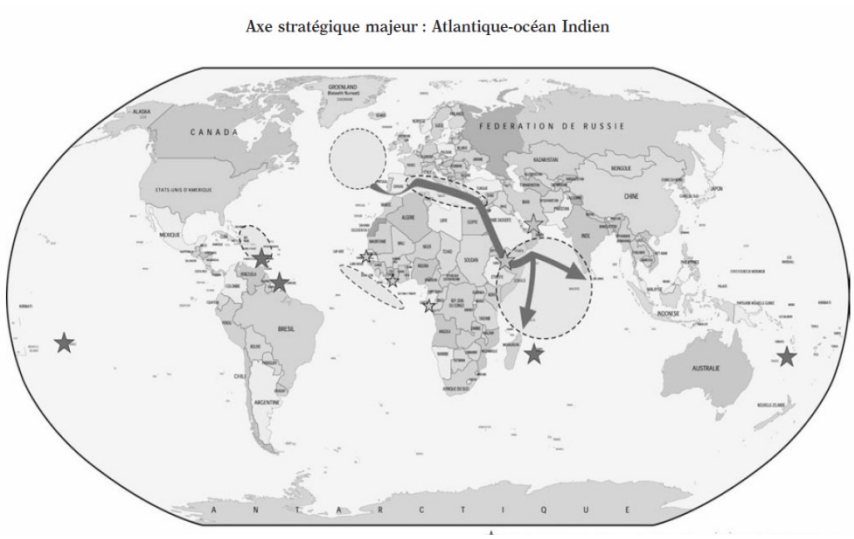

Figure 5. Main French strategic axis: from Atlantic to Indian Ocean[15]

Figure 6. EU Cooperation programs[16]

15 Ibidem.

16 Laura Canali, Balcans Special Issue - 10/ 2005, Limes, http://temi.repubblica.it/limes-heartland/eu-programs.

It is not difficult to observe the fact that the European Neighborhood Policy program is outlined within the territory of North African states, states that recently were hosts of significant popular unrest. Development of the European Neighborhood Policy program could be a guarantee for future stability of the region, allowing France to extend its influence on the African continent as a partner or rival of the USA and/or China in their race for energy resources. In this regard, the best instrument for France could be the Mediterranean Union, project which was presented in 2008 by the former French president Nicholas Sarkozy. However, implementing this instrument requires a significant financial effort that, with the current European shortage on budgets, seems to be rather difficult.

Another argument for reconsidering the strategic position of France is represented, in our opinion, by the strengthening of its presence in Africa or in its proximity, in the direction of its strategic axis. In this respect, we believe that a good example is that of the French territory which was extended by the administrative incorporation of Mayotte Island within the metropolitan French territory.

In terms of maritime competition in the Indian Ocean, Mayotte Island is a strategic place for France, the island being located halfway between Madagascar and Africa, providing this quick access to the mainland and in the meantime direct access to the Indian Ocean energy resource transport routes. The establishment of military facilities in this location is very probable, the economic potential of the island being very low. One fifth of the population lives below the poverty line and the unemployment rate is 25%. A former sultanate, colonized by France in 1841, Mayotte has a majority Muslim population, a fact that only increase the percentage of the Muslim population in a state like France, where the authorities are trying to limit cultural differences through policies prohibiting religious symbols in public.

Considering the already mentioned issues in the context of the 2011 events, and adding, the French military support in the Mali conflict earlier this year, we may conclude that, through its actions, France wants to overcome the status of regional power, engaging, as a partner or a rival of the global great powers, in the competition for energy resources.

Figure 7. Mayotte Island location in Indian Ocean, near its main strategic axis

NATO and the Smart Defence Initiative

Based on the contemporary strategic trends, the cost of Libya operations and the spectrum of an intervention in the Syrian civil war, and adding the European countries defence budgets cuts, NATO has released the Smart Defence initiative.

Although the phrase *"smart defence"* was first advanced by NATO Secretary General Anders Fogh Rasmussen at the Munich Security Conference on 2011, in his speech about the need for new approaches to *"ensure greater security at a lower cost by joint efforts and higher flexibility"*[17], the Smart Defence initiative was

17 http://natolibguides.info/smartdefence.

officially launched a year later, during a discussion that took place at the Chicago NATO Summit in May 2012.

Briefly, the initiative can be defined as NATO's response to the challenge of equitable sharing related to defence responsibilities in a time of financial austerity and national budget cuts due to the severe financial crisis. In these circumstances it is necessary to balance defence spending efforts between the U.S. and European countries on the one hand, and reduce the technological gap between U.S. and allied European states by the development of critical NATO operations capabilities by the latter ones, on the other hand. However, in order to achieve this goal, as the NATO Secretary General said in the above mentioned presentation, European countries must demonstrate political unity and determination in order to ensure the proper investment framework. Otherwise, Europe will only confirm the political differences which keep it on a less strong position, far away from the U.S[18].

In this regard, European countries should take advantage of the *Pooling & Sharing* program[19] – a program developed in the defence sector by the European Union states – in order to design, build and share the necessary capabilities and use the institutional NATO framework as the best tool for capitalizing allies' knowledge to identify the states that have similar defence needs but lack the needed resources to achieve full independent capabilities to successfully conduct NATO operations.

Although it brings a new spirit to the transatlantic cooperation, the Smart Defence initiative must face the challenges that rise from its implementation at NATO level. In this respect new tools must be developed in order to respond to the basic imperatives of the implementation of Smart Defence namely the financial, operational, commercial, industrial and legal ones.

The success of transatlantic cooperation is, in this regard, directly related to the synchronization of the North American defence market with the European defence market. If the North American market means, essentially, the U.S. and Canada, the European defence industry is mainly concentrated in six countries, namely

18 ***, *Anders Fog Rasmussen, NATO Secretary General, Calls for 'Smart Defence' at Munich Conference*, www. nato.int/cps/en/natolive/news_70327.htm.

19 Cristina Bogzeanu, *NATO - EU Relation from the Perspective of the Implications of "Smart Defence" and "Pooling and Sharing" Concepts*, Strategic Impact, no. 3/2012, "Carol I" NDU Printing House, 2012, pp. 33-40.

France, UK, Germany, Sweden, Italy and Spain. In this situation, the emergence of a transatlantic framework for cooperation in the defence industry, to regulate military equipment manufacturing activities in both the U.S. and Europe, is more than expected.

In this respect, we think that a significant role in the design of transatlantic defence cooperation will be played by the European Defence Agency, also known as EDA. EDA activity has been designed to support the development of European defence capabilities by strengthening the European cooperation forms, both in the production and marketing of military equipment, as well as the development of scientific research and technological platforms.

If in the first years of its existence the EDA got the exclusive responsibility of launching various capabilities projects, the last period recorded a rebalancing of the Member States role. The EDA approach aimed to initiate programs based on priorities that were more or less defined by consulting the Member States, based on a complicated algorithm aiming rather at the quantitative evaluation of the capabilities deficit.

Thus, by engaging *the* European Defence Research & Technology (EDRT[20]), there was accomplished a prioritization of technologies that requires investment from the Member States. In the spirit of the *"comprehensive approach"* promoted by the EDA, EDRT also covers the aspects related to the modalities to achieve European forms of cooperation, aiming to support the capabilities development.

The tools already created under the EDA institutional framework will provide a solid basis for the implementation of the NATO Smart Defence initiative, with the broad involvement of North American partners, and in an equitable regulated framework regarding the defence industry of all Member States. Romania also could contribute to a possible European consortium that is expected to be designed in the defence industry sector while exploiting the opportunities created to become eligible for specific contracts.

Our last statement relies on the fact that the Romanian national defence industry has been and continues to be a supplier of arms and ammunition on several

20 www.eda.europa.eu.

foreign markets. We think that the defence industry has the further potential to increase its export contracts, knowing that there are requests from traditional partners in arms exporting. In this regard we also think that support is needed in order to implement a series of technical and marketing measures, which, under the new regulations imposed by the implementation of Smart Defence, would attract strong Western support that would lead to the increased significance of the Romanian national defence industrial entities in the framework of programs for building, testing and acquiring share capabilities with Alliance partners.

In our perspective, Smart Defence is a pragmatic initiative whose goals are manifold:

- boosting the European *Pooling & Sharing* program that involves cooperation in the defence sector;
- reduces the defence costs for states involved, while ensuring the necessary capabilities;
- will support technological progress through research and development programs
- will create a competitive market for defence equipment
- will create financial, commercial, industrial, legal and operational instruments in order to equitably regulate the transatlantic defence market
- the emergence of a common defence market, based on the transatlantic relationship, will be a counterweight to the already traditional relationship between Russian and Chinese defence industries.

Although the positive consequences of implementing the Smart Defence initiative are numerous, there are some issues that can delay the implementation of the project. Among them are:

- the lowering the strategic flexibility through the specialization of capabilities among the allied Members;
- the possibility to achieve political unity of decisions for use at the multinational level concerning allied shared capabilities. To achieve the unity of decisions at the Member States level similar decision-making processes are required in each allied state, in other words the involved countries must have convergent national interests;
- the national governments tendencies to protect their own defence industry at the expense of allied partners, considering the fact that changes that will take

place in the defence market by creating consortia or by mergers of different companies could lead to the emergence of social costs (restructuring or downsizing the workforce, for example)

Conclusions

To sum up, the analysed strategic changes which in our view preceded the US strategic shift to the Asia-Pacific region could complicate an already complex security strategy. The US intention to transfer its efforts to the Pacific could lead to a security dilemma in the region, a region dominated by Russia, China and India, three great nuclear powers, not only in the region but at a global level. The nuclear capacity is doubled by the military transformation and economic advance, traits that could encourage an arms race in a region where there already exists tensions regarding North Korea could lead to an escalation of conflict.

At the same time, with the US efforts transferred towards the Asia-Pacific there will emerge a tendency for Asian or Eurasian powers to occupy the strategic and political space which results from the US strategic shift. In this sense it is interesting to monitor Russia's actions in relation to the NATO enlargement on the one hand and the ones with China and other Eurasian states on the other so as to see the extent of Russia's initiative to establish a Eurasian Union.

Regarding NATO, the Alliance might be challenged by the US strategic shift, a major issue being whether the efforts of NATO's European members to pursue Smart Defence and NATO Forces 2020 could close the gap between the US and European states in terms of military spending and deployment capabilities.

Concluding, the US strategic shift does not appear to bring a large scale alignment of the global balance of power, with the recent financial and economic crisis complicating the already complex competition for energy resources.

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THE VISEGRAD GROUP: EMBRACING THE DOMAIN OF OUTER SPACE

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Abstract

Space has become an increasingly relevant domain in security and defense policy. The study draws attention to significant interrelations among trends in modern warfare, emerging technologies and dependency on outer space, which pose both threats and opportunities. In particular, it highlights the indispensable role of space within prominent defense programs, including Remotely-Piloted Aircraft (RPA), Ballistic Missile Defense (BMD) as well as the prospective Prompt Global Strike (PGS). Hence, presence in the ultimate high ground of military affairs turns out as ever more important.

While the Visegrad countries have not yet recognized space as a platform for regional cooperation, recent political developments show that by 2020, all of the members of the Visegrad group may become members of the European Space Agency (ESA). By becoming active members of ESA, the V4 countries can prospectively embrace new opportunities such as the development of cosmic industry and strengthening their defense and security capabilities. Furthermore, regional cooperation in space may bring about the effects of synergy, which will provide the Visegrad countries with a substantial added value. In line with initiatives to develop multinational capabilities, the paper advocates that the Visegrad countries venture into space by launching a joint satellite in orbit by 2025.

Key words: space, outer space, regional cooperation, defense, security, Visegrad, V4

Introduction

Regional security and defense cooperation initiatives have recently gained an increasing importance within the efforts to streamline and modernize European defense capabilities. Until recently, outer space remained largely unnoticed by small and medium-sized countries. That may well change in coming years as an increasing number of states has decided to venture into this unique domain. Whereas Poland, the Czech Republic, Hungary, and lately also Slovakia have shown their interest in becoming relevant players in space, the Visegrad group may through the effects of synergy attain a substantial added value in several areas of public life, including economy, security and defense[1].

The era, in which only a handful of great powers possessed capabilities enabled by space platforms, is long over. Nowadays, nine spacefaring nations, two American private companies[2] and the community of states gathered in ESA can launch satellites into orbit. Presence in the ultimate high ground of military affairs turns out as increasingly expedient. Besides the military and intelligence use of outer space, satellites provide an essential tool in many different public services, including weather forecasting, communication, navigation and the transmission of different types of signal. In recent years, space efforts have concentrated mostly on communication -- civilian and military – followed by science services, remote sensing and meteorology[3].

In order to better understand the importance of the domain of outer space, especially in the realm of security and defense, one must take a close look at the nexus of air and space as the two increasingly interdependent mediums that prove indispensable in crisis management operations. Recent trends in military affairs have convincingly shown that the continuum of air and space will continue to play a crucial role in prevailing in future conflicts. Orbital and aerial platforms prove

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1 Pindjak, Peter and Jankowski, Dominik. *Importance of Space Domain within Visegrad Defence and Security Cooperation*. New Atlanticist. Atlantic Council of the United States (ACUS), 2012. Accessed on June 1, 2013 at: http://www.acus.org/new_atlanticist/importance-space-domain-within-visegrad-defense-and-security-cooperation.

2 Two U.S. companies have demonstrated the ability to launch satellites in orbit – SpaceX Corporation and most recently also Orbital Sciences Corporation.

3 Al-Ekabi, Cenan. *Space Policies, Issues and Trends in 2011/2012.* European Space Policy Institute (ESPI), 2012, pp. 34-35.

essential, for instance, in the use of precision-guided munition (PGM), RPA[4], BMD, and also other prospective projects such as PGS[5], all of which form the core of modern warfare.

Growing Importance of Air and Space in Modern Warfare

While most of the technological advances that allow for the use of RPA and proper functioning of BMD and PGS have been spearheaded by the United States, European nations will have to assume a greater role by investing into research and development, particularly in the domain of outer space. Otherwise, Europe will become ever more dependent on the U.S. assistance and gradually lose the ability to maintain the security of the old continent by itself. Notably, the Visegrad nations already participate in several multinational projects that take advantage of air and space, both through NATO and the EU. One of such programs, in which three of the V4 countries take part, represents the NATO Alliance Ground Surveillance (AGS) system. It has become one of the flagship multinational initiatives of NATO to develop modern capabilities for emerging security challenges. The AGS will provide the Alliance with a critical capability as a part of NATO's Joint Intelligence, Surveillance and Reconnaissance (JISR) ambition. The core system of the AGS comprises five RQ-4B Global Hawk high-altitude, long-endurance RPA operated out of Sigonella base in Italy. The RPA Command and Control (C2) as well as the Intelligence Surveillance and Reconnaissance (ISR) data transmission will be conducted through a space component.[6] Indeed, AGS presents a prime example of the importance of air and space domains in modern warfare.

4 For further reference in the paper, the term RPA refers to Unmanned Aerial Vehicles (UAV) that operate beyond line-of-sight using orbital platforms such as the RQ-4 Global Hawk and MQ-9 Reaper aircraft.

5 The paper mainly refers to the conventional version of the PGS concept known as the Conventional Prompt Global Strike (CPGS).

6 NATO Alliance Ground Surveillance Management Agency (NAGSMA). *General Information.* NAGSMA Website. Accessed on June 1, 2013 at: http://www.nagsma.nato.int/Pages/AGS_General_Information.aspx.

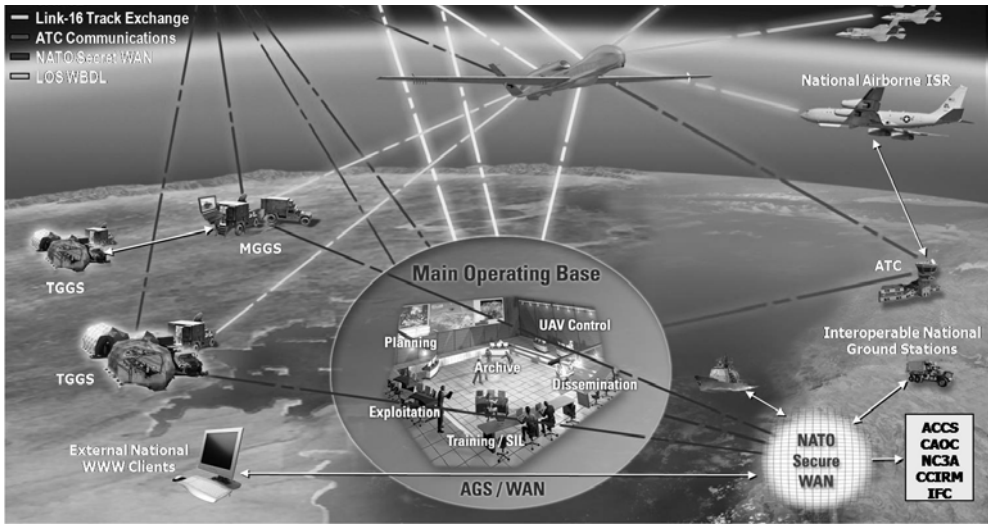

Table 1. NATO AGS Concept (Source: NAGSMA)[7]

Whereas the AGS remains one of the NATO's most prominent smart defence projects, RPA projects are also developed by the EU as well as some other multinational groups in Europe. The EU leads an RPA project intended for civilian use only under the program named Remotely Piloted Aircraft Systems (RPAS). It advocates the utility of RPA as a unique platform capable of delivering a wide range of services including monitoring of natural resources, communication services and infrastructure inspection.[8]

Another notable multinational project developing a military RPA is led by France and involves government and industry partners from Greece, Italy, Spain, Sweden and Switzerland. This group works on the prototype of a first European Unmanned Combat Aerial Vehicle (UCAV) known as Neuron. The Neuron UCAV took of for its maiden flight in December 2012. By reaching full operational capability, Neuron will fly at the speed of sound and carry PGM, either with conventional or nuclear payload.[9]

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7 Ibid.

8 European Commission. *Remotely Piloted Aircraft Systems.* European Commission Website. Accessed on June 1, 2013 at: http://ec.europa.eu/enterprise/sectors/aerospace/uas/index_en.htm.

9 Dassault Aviation. *nEUROn program.* Dassault Aviation Website. Accessed on June 1, 2013 at: http://www.dassault-aviation.com/en/defense/neuron/introduction/.

To ponder upon the future use of European RPA, one has to follow the advances spearheaded by the United States, which recently crossed two important milestones in this field. Whereas the Central Intelligence Agency's (CIA) Counter-Terrorism Center (CTC) operates more than 80 RPA, including Reapers and Predators that are specially outfitted for intelligence missions and covert actions, U.S. Navy recently conducted the first ever RPA aircraft carrier launch with its X-47B Unmanned Combat Air System demonstrator, initially developed by the Defense Advanced Research Projects Agency (DARPA).[10] Meanwhile, DARPA works on several projects involving hypersonic cruise vehicles. One of them, the X-51A Waverider recently made a successful test flight that lasted more than three minutes and reached the hypersonic speed of five times the speed of sound. In the future, the amazing scram-jet engine could not only be used in aircraft, but also in cruise missiles. According to U.S. Air Force, the technology may be integrated in hypersonic weapon systems by 2020–2025 time frame and prospectively enter the battlefield by 2030.[11] In any case, whether it will be used on RPA, missiles, or both, the system will be dependent on satellites for communication, navigation and guidance.

Yet RPA will not only serve in military capacity as the European Union already considers introducing RPA in civilian airspace. Under the project DeSIRE, ESA and the European Defence Agency (EDA) recently conducted a series of tests to integrate military RPA in civilian airspace. The last test was conducted in close cooperation of Spain and Israel. In the exercise, the on-ground pilot of an Israeli Heron 1 RPA successfully communicated via satellite with the pilot of a Spanish manned aircraft and managed to divert a possible collision.[12]

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10 Roston, Aram. *CIA's Fleet of 80+ UAVs Unlikely to be Transferred to Military.* DefenseNews, 2013. Accessed on June 1, 2013 at: http://www.defensenews.com/article/20130515/C4ISR/305150026/Targeted-Killing-CIA-s-Fleet-80-UAVs-Unlikely-Transferred-Military.

11 McGarry, Brendan. *Air Force Sees Hypersonic Weapons in 2025.* DefenseTech, 2013. Accessed on June 1, 2013 at: http://defensetech.org/2013/05/13/video-air-force-sees-hypersonic-weapons-in-2025/.

12 Opall-Rome, Barbara. *Israel Tackles the Last Frontier of UAV Technology.* DefenseNews, 2013. Accessed on June 1, 2013 at: http://www.defensenews.com/article/20130603/C4ISR01/306030015/International-ISR-Israel-Tackles-Last-Frontier-UAV-Technology.

Space as Indispensable Component of BMD and PGS Concepts

Besides RPA, space provides for an essential component in other high-tech defense programs such as BMD and PGS. Even though these technologically sophisticated projects remain largely the prerogative of the United States, European allies, and to some extent also Visegrad countries, carry the potential to actively engage in them. With regard to BMD, Poland remains the strongest protagonist of this initiative within the Visegrad group. Following up on the scrapped plan of the George W. Bush administration, in which the Czech Republic and Poland supposed to host the core European element of the U.S. national BMD system, the biggest V4 country now expects to host a BMD interceptor site within the Barack Obama's plan known as the European Phased Adaptive Approach (EPAA). By 2018, the Polish base complemented by a similar site in Romania will form an integral part of EPAA and perhaps also NATO missile defense system, which will provide coverage of all European NATO territory against ballistic missile threats launched from states like Iran and North Korea. Within the Alliance itself, the issue of BMD has resonated for already a few decades. The main focus of NATO lies in the limited, area-specific BMD protection. Known as Active Layered Theatre Ballistic Missile Defence (ALTBMD), the NATO system seeks to protect forward-operating troops from short- and medium-range ballistic missile threats using a sophisticated BMD architecture. As any sophisticated BMD system, ALTBMD also counts on an early warning space-based component. Pursuant to the first operational capability declared in 2010, NATO plans to achieve full operational capability of ALTBMD by 2018.

Yet Poland does not seem to reconcile with the idea of relying solely on either bilateral or multilateral agreements when it comes to BMD. In April 2013, Polish President signed an amendment that earmarks more than 30 billion Euro to build a national BMD system.[13] Poland seems resolute in building an area-specific BMD system that will provide protection against short-range ballistic missiles.

13 Agence France-Presse. *Poland Guarantees Funds for Missile Shield.* DefenseNews, 2013. Accessed on June 1, 2013 at: http://www.defensenews.com/article/20130412/DEFREG01/304120012/Poland-Guarantees-Funds-Missile-Shield.

Furthermore, Poland remains open to any negotiations to extend its BMD umbrella project to regional partners, which certainly presents a unique opportunity to the Visegrad group. In line with the growing significance of air and space continuum, in addition to the protection against ballistic missile, any BMD system includes components relevant to air defense. While some of the V4 countries have already engaged in discussions on a joint radio-location field as well as signed bilateral cross-border air operations agreements, the prospect of initiating consultations on a regional BMD initiative may not seem too distant.

Space Capability	NATO Uses (not all inclusive)	Example Systems
Position, Velocity, Time and Navigation	• Precision strike • Force navigation • Support to PR/CSAR • Network timing	• Global Positioning System (US) • Galileo (EU)
Integrated Tactical Warning and Threat Assessment	• Force protection • Attribution • Missile defence	• Space Based Infrared System (US) • Spirale (FRA")
Environmental Monitoring	• Mission planning • Munitions selection • Weather forecasting	• Defense Meteorological Satellite Program (US) • EUMETSAT (EU)
Communications	• Command and Control • Unmanned Aerial Vehicle ops • Deployed communications	• Syracuse (FRA) • SICRAL (ITA) • SKYNET (UK)
Intelligence, Surveillance and Reconnaissance	• Order of battle • Battle damage assessment • Targeting	• SAR Lupe (DEU) • COSMO SKYMED (ITA) • HELIOS (FRA)

Table 2. NATO use of space (Source: NATO JAPCC)[14]

The United States does not only present a leader in technology used in RPA and BMD, but also in the concept of PGS, a long-term U.S. program to develop the capability of engaging geographically remote targets with hypersonic strikes. The non-nuclear PGS project, which involves the sole use of conventional strikes, known as the Conventional Prompt Global Strike (CPGS) has received much attention among military planners and policy makers, particularly after the U.S. Nuclear Posture Review of 2001 that emphasized the role of conventional weapon systems in long-range strike missions. Whereas initially the U.S. Department of

14 NATO Joint Air Power Competence Center (JAPCC). *Filling the Vacuum: A Framework for a NATO Space Policy. JAPCC*, 2013.

Defense considered ballistic missiles as the primary vehicle for the CPGS mission, emerging technologies have gradually paved the way for experimenting with innovative concepts. Most of these draw on a modified ballistic missile fitted with a hypersonic glide vehicle.[15] While the proposed missile would not follow regular ballistic trajectory, it would alleviate strategic concerns that its launch might have been misinterpreted as the launch of an Intercontinental Ballistic Missile (ICBM). Prospectively, CPGS may comprise of several launch platforms and hypersonic vehicles such as the X-51A that may eventually travel at up to 15 times the speed of sound. Regarding the launch platform, forward-based systems with global reach such as aircraft carriers, submarines, and possibly even space-based system that could deorbit an air-breathing vehicle into the atmosphere represent the most effective option for the successful implementation of the CPGS concept. In any case, the proper functioning of a military system with global reach such as CPGS will be dependent on space.

Trends in modern warfare suggest that future conflicts will continue to involve and to a large degree become reliant on space-enabled capabilities. The weaponisation of outer space itself, however, remains the subject to future national policies and prospective international norms that seek to prevent a cosmic arms race. Nevertheless, the most prominent space warfare simulation exercise known as Schriever Wargames, which is conducted annually in the United States, does consider scenarios that deal with conflicts extending to the domain of space. In 2012, the Schriever Wargame featured an irregular warfare scenario, in which allied forces became vertically flanked as the opponent forces interfered with their space and cyberspace capabilities. The wargames not only highlighted the importance of these domains in future conflicts, but also pointed to several weaknesses of the Alliance to respond to evolving challenges. NATO does not seem to have embraced space with all the threats and opportunities concerned. It lacks space policy, responsive organizational structure and also subject matter

15 Scheber, Thomas and Guthe, Kurt. *Conventional Prompt Global Strike: A Fresh Perspective.* Comparative Strategy - Volume 32. Routledge, 2013, pp. 21-23.

experts. While some allies would welcome the inclusion of similar scenarios in NATO STEADFAST exercise series, the Alliance as a whole does not seem ready to handle such a challenge yet[16].

Conclusion: Prospect for Regional Cooperation in Space

Pursuant to the U.S. shift of geostrategic focus to the Asia-Pacific region, Europe needs to assume greater responsibility for the security of the continent. In line with the concept of smart defence, regional security and defense cooperation has continued to attract attention of European policy makers, particularly in Nordic and Visegrad countries. Indeed, the V4 nations recently significantly boosted their cooperation in several areas of defense, including the joint EU Battle Group (EU BG) and Special Operations Forces (SOF). In contrary to the Nordic countries, however, the Visegrad group has not yet embraced the domain of space as a prospective area for cooperation. The Nordic Defense Cooperation (NORDEFCO) acknowledged the importance of outer space in Stoltenberg report of 2009, which proposed the establishment of a joint polar orbit satellite system for communication and remote sensing purposes. The Nordic countries expect that the space system will in the long-term bring the users tangible benefits, including the provision of own space-based communication and ISR capabilities. While the V4 nations continue to shore up cooperation in different areas, space may in the short-term become another subject of joint interest. Recent trends in military conflicts have convincingly shown that space will continue to play a significant, if not indispensable role in international crisis management operations.

Whereas most of the Nordic countries are members of ESA, only the Czech Republic and Poland enjoy membership in the European space club within the Visegrad group. In light of recent developments, however, all Visegrad nations may become members of ESA by 2020. The Czech Republic joined ESA in 2008 and has been spearheading space endeavors within Central Europe. Poland joined

16 Waller, H. Todd. *Schriever Wargame 2012 International.* NATO Joint Air Power Competence Center (JAPCC) Journal – Spring/Summer 2013. Accessed on June 1, 2013 at: http://www.japcc.de/fileadmin/user_upload/journal/Edition_17/2013-04-10-Journal_Ed-17_web.pdf.

ESA structures in late 2012 and has already shown a strong interest in security dimension of outer space. Hungary expects to become a member of the agency in a few years. Last, but not the least, Slovakia recently announced it would like to sign the European Cooperating State (ECS) agreement as well as a plan of cooperation with ESA, which would set the country on a 5-year road to join the agency.

Venturing in space by launching a joint V4 satellite by 2025 would bring the Visegrad group lasting benefits including bolstering of its defense and security capabilities as well as building up its cosmic industry. Establishing a satellite support infrastructure is not only about space, but also about ground segments that may prove useful in other missions such as the surveillance of air and space. Furthermore, if the countries continue to build their forces to support multinational expeditionary operations, space-enabled capabilities will continue turn out as ever more indispensable. In summary, regional cooperation in space may bring the Visegrad group about the effects of synergy, which will provide the nations with a substantial added value in several areas of public life, including economy, security and defense.

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NATIONAL SECURITY

AIR AND MISSILE DEFENCE SYSTEM OF THE REPUBLIC OF POLAND

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Abstract

The article deals with the key aspects of the air and air missile programs as the consequence of the evolving security environment, which prompted major international actors to initiate appropriate actions aimed at assuring effective defence against ballistic missile threat. The author focuses on three key programs. First one – the United States defence missile program, perceived as a vital element of the state security strategy. Second one – the NATO ballistic missile defence which main purpose is to develop a capability needed to protect Allied forces engaged in out-of-area operations against short and medium range ballistic missiles. Third one - the Polish air and missile defence endeavors seen from the role of the Polish military industry in the development of „the Shield of Poland", as the national and ambitious program. Finally, the National Defence University and other military research institutions contribution to development of the Polish Air and Missile Defence System is considered.

Key words: security threats, capabilities, air and missile defence, NATO, United States, Poland

Introduction

Ballistic missiles have become means of power projection in a regional and strategic context enabling countries to launch surprising attacks from a distance. Missile technology is available nowadays to a number of state actors hostile to Western democracies, but the threat may become even more serious if such

technologies fall into the hands of non-state, radical organisations. Nowadays, more than thirty countries posses ballistic missiles, which may be used to carry not only conventional warheads, but also warheads containing weapons of mass destruction. Sophisticated ballistic missile technologies available to Iran and North Korea increase the lethality and effectiveness of missile attacks and allows more accurate attacks against targets over longer distances. The evolving security environment prompted major international actors to initiate appropriate actions aimed at assuring effective defence against ballistic missile threat. NATO launched a ballistic missile defence feasibility study in 2002 to examine options for protecting Alliance forces territory and populations against the full range of ballistic missile threats. At the NATO Summit in Chicago in May 2012, after nearly a decade of vigorous efforts, the Alliance was able to declare an Interim Capability in ballistic missile defence, and new steps are now being taken to expand the protection of NATO European populations and territory against the full range of ballistic missile attacks. The decision by the US Government to adopt a phased, adaptive approach for missile defence in Europe gave a new impetus to the Alliance efforts for creation of upper layer and territorial missile defence capability. Poland has firmly declared its commitment and willingness to contribute to NATO ballistic missile by modernizing its air and missile defence system and allowing basing of the US missile defence components on its territory.

The concept of acquiring limited ballistic missile defence capabilities as a part of the national air defence system modernisation has resulted from a deliberate assessment of security environment and future operational requirements. Concerned with the security of the territory of the Republic of Poland, safety of its citizens and most important facilities, the political authorities found it essential for the existing anti-aircraft system to be rearranged and the anti-ballistic missile defence system to be created from the ground up. Another factor that was present in the considerations related to a future air and missile defence system was the status and operational capabilities of existing air defence assets. The realisation that combat (operational) value of the present air defence system as a whole decreases steadily and the consequent retirement of the outdated air defence surface to air missile sets is imminent, produced tangible political and legal results.

Diagnosis of the operational capabilities, including that of the Air Defence system of the Republic of Poland was present in both Strategic Defence Reviews

of 2006 and 2011, and was taken into consideration in the final report of the National Security Strategic Review in 2012. Additionally, the NATO Lisbon and Chicago summits commitments constituted exceptionally strong premises for Poland to undertake adequate actions in that regard. It is worth noticing that concrete outcomes related to missile defence capabilities became clearly visible relatively quickly. The missile defence was named one of top priorities for the force modernisation between 2012 and 2022. The presidential bill on the missile defence of the Republic of Poland was put to the vote of the Polish Parliament and passed recently. The law provides a stable financing mechanism necessary for a long-term modernization of national air and missile air defence system.

With adaption of the new law, an efficient and financially viable realization of the air defence system modernization will allow the Armed Forces of the Republic of Poland to obtain a qualitative capability, which they do not possess presently. Ballistic missile capability will be indispensable to ensure a proper level of national security and also will allow force protection needed for effective engagement in crisis response situation outside the country. Evolving threats related to the proliferation of the WMD and missile technology make Poland's actions aimed at obtaining limited ballistic missile capability well reasoned and fully justified.

To better understand Poland's philosophy that underpins ongoing efforts to modernize its air and missile defence system, one needs to examine more closely related US and NATO ballistic missile defence programs. While US missile defence programs deal with all types of ballistic missile threats worldwide, the US Government works closely with European Allies to ensure seamless integration of American and NATO missile defence capabilities. The Phased Adaptive Approach for Missile Defence in Europe makes US efforts intertwined with NATO Ballistic Missile Defence, with harmonisation of tasks, capabilities and a common timing. As Poland recognises its membership to the NATO and its bilateral strategic partnership with the US as a cornerstone of its national security, it tries to make sure that national efforts undertaken to achieve major operational capabilities are in concert with respective Allied efforts, including the US.

US missile defence programme

The European and Polish connection to the US ballistic missile defence is a result of American pledge to protect its Allies and friends. The US missile defence system from its beginning has been perceived as a vital element of the state security strategy. The first stage of the system development, as well as the present one, are confirmation of that thesis. Effective functionality of the US ballistic missile defence system would ensure not only realization of defensive functions, but also a deterrence function. Thus, it will discourage the rogue states from developing their offensive missile potential. Presently, American system, known as "Ballistic Missile Defense" ensures the security not only of the territory of the United States, but also of its European and Asian allies, by assuring defence against ballistic missile attacks from unstable states.[1]

Respective elements of the US ballistic missile defence system are assessed as being at various levels of technological maturity and operational capabilities. The concerns of military experts are especially related to the elements of the engagement segment of the system**,** designed to intercept a ballistic missile in the early stages of its flight. Destroying an enemy missile in the initial phase of flight is considered as the most favourable for the defending party, as it cannot be ruled out that the missile carries a warhead with a WMD. Thus, it seems legitimate to assess that a hostile state launching a ballistic missile intends to cause as many casualties and damages as possible and would therefore employ a nuclear, biological or chemical warhead. Taking into consideration possible effect of intercepting such a missile (destroying it in the air, and in consequences, unleashing the danger it carries), the safest solution is to do it over the adversary territory.

The US missile defence system has significant international dimension and importance. The architecture of the system is formed by elements deployed not only in the United States, but also on the territory of some European countries like the United Kingdom, Denmark and in close prospect – in Poland and perhaps in Romania. Moreover, the United States cooperate closely with other states all

1 *The Threat*, Missile Defense Agency, U.S. Department of Defense, available from: http://www.mda.mil/system/threat.html, Accessed on 02 March 2013.

over the world[2] upon some components of the missile defence system, especially concerning naval and land-based ones. Preliminary American plans for ballistic missile defence called for deployment on the Polish territory of the Ground Based Interceptor designed to destroy even long range ballistic missiles. However; later on, after the President Obama's administration changed its approach to missile defence, it is fair to assess that possible future US ground components in Europe may be different from the previously envisioned system of intercepting missiles. Even so, the Phased Adaptive Approach for Missile Defence in Europe will ensure that a long-term integration of the US and NATO efforts in the field of ballistic missile defence, reflects in close consultations and cooperation between Allies, to include Poland.

The current project of the US segment of the NATO missile defence encompasses four phases that allow for a more flexible, capable and cost-effective architecture in the future. The stage one encompassed the deployment of current and proven maritime and ground-based missile defence systems to Europe to address regional ballistic missile threats to Europe and American deployed personnel and their families. Second phase of the Phased Adaptive Approach for Missile Defence in Europe is expected in the 2015 timeframe and will include deployment of more capable versions of interceptors along with more capable sensors to improve the protection against short and medium range missile threats. During phase three, expected to take place around 2018, new generation of interceptors (currently under development) will be deployed to Europe to counter possible threat of short, medium and intermediate range ballistic missiles. Ultimately, the phase four activities in the 2020 timeframe, will field improved new generation of interceptors that are capable of addressing not only previously mentioned missile threats, but also the potential future intercontinental ballistic missile threat to the United States.[3]

For obvious reasons, Poland has been particularly interested in completion of the third and fourth phase of the US European Phased Adaptive Approach. The

2 Japan and South Korea are enumerated among the states which are most closely cooperating on missile defence with the US.

3 *The Phased Adaptive Approach for Missile Defense in Europe, Fact Sheet*, Missile Defense Agency, 15 January 2013, available from: http://www.mda.mil/global/documents/pdf/paa.pdf, accessed on: 02 March 2013.

issue of deployment on Poland's territory a modified naval system of interceptor missiles as a land based system is undergoing thorough analyses because of related operational, economical and political considerations. Potential advantages of deploying such system in Poland, are being judged from a wider perspective that takes into consideration also possible indirect benefits for Poland and the NATO. Thus, deliberate assessments and consultations are considered as an effective tool to avoid accusations and overly critical opinions on the deployment of the US air and missile defence elements in the Republic of Poland. Having said that, the links between the US ballistic missile defence, particularly its European Phased Adaptive Approach part, and the modernization efforts of Poland's air and missile defence systems are clearly visible and understandable.

NATO Ballistic Missile Defence

The ballistic missile threat was recognised by the NATO more than two decades ago. The Strategic concept of the North Atlantic Treaty Organization, accepted during the Summit in Washington in 1999, called for defence potential to face threats related to proliferation of the WMD. It was recognised, as Peter Flory puts it, that the Alliance needed to create *"a balanced mix of forces, response capabilities and strengthened defenses".* Therefore, it was not a surprise that during the Prague Summit the leaders of the allied states made a decision on an analysis increasing capability of air defence, armed forces and management centres. A study conducted on NATO air defence feasibility was the result of that decision.

NATO ballistic missile ambitions were institutionalised in 2005, when the Active Layered Theatre Ballistic Missile Defence (ALTBMD) programme was established. Its main purpose was to develop a capability needed to protect Allied forces engaged in out-of-area operations against short and medium range ballistic missiles[4]. The level of ambitions rose up at the November 2010 Lisbon Summit, when the agreement was reached by the heads of NATO states and governments

4 *Media Fact Sheet NATO Active Layered Theatre Ballistic Missile Defence (ALTBMD)*, NATO Public Diplomacy Division, Brussels September 2011.

to provide the missile defence for NATO European populations and territory against the full range of ballistic missile attacks. Alliance concept of ballistic missile defence calls for layered weapon systems, including sensors and effectors, for high and low-altitude defences against ballistic missiles. National surveillance and engagement capabilities are to be integrated with NATO communications, command and control and battle management software.[5]

Similarly to the US solutions, NATO Ballistic Missile Defence is designed to evolve over time. The ballistic missile coverage will gradually expand and extend with the ultimate goal to provide protection for all European populations, territory and forces. The Interim BMD capability has been declared on 27 January 2011, and the elements of the US European Phased Adaptive Approach constituted the primary assets available to the NATO ballistic missile defence system. Initial Operational Capability of the NATO Ballistic Missile Defence is expected at the end of 2014, when a more capable lower layer of C2 system will be deployed, full integration of air and missile defence systems will be achieved and links to assets of the US European Phased Adaptive Approach will be strengthened[6]. The Full Operational Capability of Allied Ballistic Missile Defence is expected before the end of the current decade. NATO Ballistic Missile Defence is more than just interceptors and sensors. The command and control system of missile defence will enable five key functions that are crucial to the protection of NATO populations, territory and deployed forces: planning, monitoring, information sharing, interception and consequence management. The development of missile defence capability by NATO is focused on two distinctive, but mutually reinforcing, objectives. The theatre missile defence segment of ballistic missile is intended for protection of Allied forces during out-of-area operations. The defence for NATO's European populations territory and forces will be provided by a territorial segment of the ballistic missile defence programme. As the threat of ballistic missile is common not only for the NATO members but also other countries in Europe, the Alliance invited Russia during the Summit in Lisbon to cooperate with NATO on missile defence. Although Russia's President agreed on this goal, the progress on NATO-Russia cooperation is regrettably slow. Nevertheless, NATO strongly believes

5 *NATO Ballistic Missile Defence (BMD)*, NATO Public Diplomacy Division, Brussels October 2012.

6 Ibidem.

as it was expressed in September 2012 by the NATO Deputy Secretary General that cooperation between NATO and Russia to defend against a common missile threat through linked sensors, sharing early warning information and coordinating interceptions, would benefit both sides.[7]

The unique feature of the NATO Ballistic Missile Defence program is the division of responsibilities between member states and the Alliance. Member states provide sensor and engagement systems for the missile defence, while NATO itself integrates those national assets using allied communication and command and control systems. Another form of national contributions to the ballistic missile defence is host nation support to the allied and national missile defence assets. Poland, along with Romania, Turkey and Spain decided to host US missile defence assets needed for NATO ballistic missile defence. Germany hosts command and control facilities for the missile defence system. Pooling resources from all member states allow covering the costs of the missile defence programme. Ongoing efforts to develop alliance missile defence capability provide an example of Allies commitment to adapting to new and emerging security environment. As such they prove that the idea of Smart Defence is alive and brings tangible effects in delivering a capability that single member states would not afford to acquire on their own. Taking that into account, one can see that the Polish air and missile defence system modernization efforts fit well into comprehensive actions undertaken by NATO to create the theatre and territorial segments of Allied Ballistic Missile Defence system.

Polish Air and Missile Defence programmes

The Plan for Technical Modernisation of the Armed Forces 2013–2022 accepted by the Government of Poland includes specific goals related to air and missile defence systems. Six batteries of new generation WISŁA medium range surface to air missiles with ballistic missile defence capability are planned to be

7 NATO's Vision for missile cooperation with Russia. Address by Ambassador Alexander Vershbow, Deputy Secretary General of NATO to the Moscow Missile Defence Conference, 3 May 2012, available from: http://www.nato.int/cps/en/SID-AE868370-664A519A/natolive/opinions_86832.htm?selectedLocale=en, accessed on 10 March 2013.

acquired by Poland's Armed Forces prior to 2022. Beside that, the acquisition of 11 batteries of new generation short range NAREW surface to air missiles is planned. Modernisation plan for air defence calls also for procurement of 77 mobile VSHORAD POPRAD systems, 400 man-portable air defence systems (PIORUN) and six batteries of hybrid artillery and missile PILICA systems. The modernization plans include also procurement of deployable radars (19 BYSTRA radars and 8 SOŁA radars).[8]

Presidential initiative to boost the development of missile defence component within the air defence systems relates closely to the governmental modernization plan. According to the proposal made by the Presidential National Security Bureau, a prospective Air Defence of the Republic of Poland should encompass two mutually reinforcing elements: air (anti-aircraft) and anti-ballistic defence. Effective functionality of the mentioned elements requires first of all an ability to destroy a broad spectrum of air-breathing and ballistic threats, including cruise and ballistic missiles of short and medium range. It is therefore necessary to field land-based capability which would intercept mentioned ballistic missiles in the range of at least 100 kilometres away of defended objects. What is more, such medium range air and missile defence systems should posses considerable mobility and significant operational independence. An air and missile defence system, which would be able to fight both aforementioned (conventional and ballistic) threats with the same or at least similar effectiveness, seems to be an optimal solution. Among such systems one can list: the American Patriot, the French-Italian-American MEADS, the Russian S-300W, or the French-Italian SAMP/T. All the mentioned systems can theoretically fight against ballistic missiles in the final stage of their flight. Yet achieving the desirable multifunctional character of missile system is not an easy task, what is well known to the constructors of the Aster system. The obvious difference between presidential initiative for missile defence and governmental plans for modernization of air defence relates to the timeframes. The Presidential National Security Bureau proposes one year delay in fielding missile defence capabilities. The missile defence project has been proposed to start in 2014 and conclude in 2023 with the capability fielded.

8 *Plan modernizacji technicznej Sił Zbrojnych w latach 2013–2022*, Ministerstwo Obrony Narodowej, Warszawa 2012, available from: http://www.mon.gov.pl/pliki/File/Modernizacja_techniczna/program_uzbrojenia_8032013.pdf, accessed on 10 March 2013.

The capability will be achieved throughout phased acquisition of air and missile defence. Missile defence capabilities will gradually increase as modules (batteries) of medium range SAM systems are fielded and reach initial operational and then full operational capability.[9] The Presidential National Security Bureau prepared a proposal of legislation to assure stable funding of missile defence project. The project was voted by the Parliament and approved.

The modernization of Poland's Air Defence System has also a significant industrial dimension. Multiyear research, development and production of sensors, shooters and command and control elements for air and missile defence attract attention of defence industry across Europe and beyond. Because transfer of modern technologies to Poland's defence industry is one of the requirements, proposals from foreign partners include notions of close cooperation. The best known industrial proposal for air and missile system is the project proposed by the Polish military industry group BUMAR under the name "the Shield of Poland". The project intents to integrate elements of air and missile defence, creating a complex, layered system of air defence against current and future air and missile threats. Three layers of VSHORAD, SHORAD and MRAD are expected to form a highly effective adaptive air and missile system, that will be fully interoperable with NATO Integrated Air Defence System and NATO Integrated Air and Missile Defence System in the future (NATI AMDS)[10].

In the light of the aforementioned circumstances, a question on the role of the Polish military industry in "the Shield of Poland" programme emerges naturally. There are no doubts that it is a great opportunity for our enterprises producing air defence hardware, yet can they realise such an ambitious project single-handedly? Results of the study on feasibility, which constituted an outcome of research projects upon the future air and missile defence system, suggest that up to 60% of the components of the entire system can be delivered by the Polish military industry itself. The other 40% has to be developed with international

9 S. Koziej, *Obrona przeciwrakietowa w ramach obrony powietrznej RP (przesłanki i założenia koncepcji)*, Biuro Bezpieczeństwa Narodowego, Warszawa, październik 2012, available from: http://www.bbn.gov.pl/portal/pl/2/4186/Koncepcja_obrony_przeciwrakietowej.html, accessed on 10 March 2013.

10 *Tarcza Polski*, Bumar Elektronika, available from: http://www.bumar.com/elektronika/o-firmie/projekty-strategiczne/tarcza-polski/, accessed on 10 March 2013.

cooperation. However, it seems that despite the achievements of our military industry such assessment is a bit too optimistic. In this context, it is desirable to create international consortia, which would include Polish enterprises. The pressure of time naturally forces Poland to make use of the existing and useful achievements, outputs and experiences, what in consequence would lead to save some of the precious time during developing and implementing modern system solutions of air defence.

The National Defence University and other military research institutions contribution to the development of the Polish Air and Missile Defence System

All military universities, research and academic institutions, which could make a contribution, should be engaged into the developments of the Polish Air and Missile Defence System. The US ballistic missile defence system as well as systems of other NATO allies are subjects of the academic research conducted in the National Defence University. It should be underlined that such research projects have taken place at our University since the nineties of the last century. In that period, research projects have focused mainly on the developments of the American ballistic missile defence system. NDU academic instructors took part in numerous meetings organised by the US Missile Defense Agency and by the Polish Ministry of National Defence.

Air and missile defence issues are complex ones. They demand multidisciplinary approach, more academic attention and further researches. Since the significance of the US, NATO and Polish air defence systems to the national and international security is enormous, the potential for international and multidisciplinary research cooperation is enormous. The Contribution of the National Defence University to such research project may relate analyses of operational employment of air and missile defence systems, operational scenarios and command and control requirements. The Military University of Technology in Warsaw possesses significant scientific potential which can be exploited in technology research projects and implementation of the national system of air defence. In this case it may relate to the employment of the most up-to-date air and missile defence

technologies and developing unique technical solutions. Academic and research institutions proved to be reliable partners of industrial partners in a number of multidisciplinary research and development projects. Finally, academic freedom of discussion allowed open and honest exchange of opinions between various air and missile defence stakeholders during numerous workshops, seminars and conferences. The interconnectivity between NATO, US and Polish efforts on missile defence will surely effect in an increased scientific and academic cooperation in the field of operational art, technology and training.

Conclusions

Discussion of the concepts, plans and actions related to Poland's Air Defence System needs to take into account a broad spectrum of factors, circumstances and consequences. Modernisation efforts that have been undertaken by Poland to modernise its air defence system and acquire a limited ballistic missile capability should be viewed as a part of Allied actions aimed at protection of NATO populations, territory and forces against the threat of ballistic missile attacks. Technical modernisation plans adopted by the government call for the acquisition of medium range air defence surface to air missile systems that will be able to intercept tactical ballistic missiles in the timeframe of 2022. The development and fielding of missile defence capability will require international military and industrial cooperation. While it is a challenging endeavour, it offers a strategic opportunity to improve allied cooperation within NATO concept of smart defence and reinforce bilateral cooperation between Poland and the US. Modernisation of Poland's air defence system offers a unique opportunity for domestic defence industry to increase its competitiveness and technology transfers. It enables also Poland's academic and research institutions to increase research cooperation with foreign partners and engage in multidisciplinary research and development projects with industrial partners. As challenging and demanding may be the modernisation of Poland's Air Defence System, so unique and promising are the prospects of development of military capabilities, industrial potential and research activities related to missile defence in Poland.

CZECHOSLOVAK AND CZECH REPUBLIC WEAPON PRODUCTION AND ECONOMIC SECURITY IN HISTORIC PERSPECTIVE

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Abstract

The main aim of this article is to describe the historical development of the weapon production and defence industrial base of Czechoslovakia and the Czech Republic, simultaneously the authors try to point out the importance of weapon production and defence industrial base as a component of the economic security of a state. The article is divided into three parts; each part delivers a picture of the extent, structure and position of weapon production and the defence industrial base in separate timeline phases of both the Czechoslovak and Czech nation. The first period shows Czechoslovakia as an important representative of the international arms trade. The second period characterizes Czechoslovak weapon production under the condition of the strong influence of the Warsaw pact and the Council for Mutual Economic Assistance. The third part describes Czech arms production during dynamic changes after the cessation of the bi-polar system. In the conclusion of the article, the authors underline the idea of the importance of weapon production as the tool of economic security.

Key words: Weapon Production, Economic Security, Defence Industrial Base, Czechoslovakia, Czech Republic

Introduction

After World War I, hardly any country built its armed forces with such difficulties as the Czechoslovak Republic did. The building up of the defence industry had also to cope with these difficulties. After the inception of Czechoslovakia in 1918, there was a great number of enterprises that were mostly engaged in supplying the armed forces and they were under direct military supervision. These enterprises, representing the "war industry", were divided into groups of factories managed by appointed senior officers. The organization of weapon production enabled the economical use of material through purposeful distribution and consumption.

The military exerted every effort to strengthen the defence industry, make it reliable, achieve the country's self-sufficiency as far as possible and have the war industry thoroughly prepared for cases of emergency. The arms industry has undergone a considerable transformation since the early 1990s in the context of the changing security environment and the significant decrease in demand for military equipment after the end of the cold war.

Czechoslovak weapon production in 1918–1939

Prior to the inception of an independent Czechoslovakia, did not have particularly large levels of arms production which had already been developed on its territory.

Therefore, it is not true that Czechoslovakia inherited a well-developed defence industry from the Austro-Hungarian Monarchy and just continued in military production and export. The structure of the defence industry on the country's territory did not meet the demands of newly formed Czechoslovak Armed Forces and therefore up until 1925, in the foreground was a build up of the domestic defence industry. These, together with the older Škoda Factory, were intended to spearhead export. Therefore, the first years after 1918 were not under the sign of arms export but rather their import.

Within 1920 – 1926, based on the aforementioned main producers and by means of predominantly inland capital, a very modern defence industry was built up. The arms production started to develop just at the time when the allocation of the military budget was changed. That is why in 1926 the "Fund for material needs of national defence" was established by Act No 240/1926. The annual drawing up of a budget was not bound with any credit deadline. These unlimited credit terms enabled the expansion of military production.

In 1935 the government established an independent organization for foreign trade – OMNIPOL, and from 1938, with a broad agents' network used partly also for the mediation of arms exports.

During the whole inter-war period, Czechoslovakia (the CSR, CS) was included among the top ten world exporters and, according to annual reports of the Community of Nations in Geneva, four times it took up the second or third place. In 1934 and 1935 even the first place. The gain from foreign trade in arms was very high. Even then, however, Yugoslavia, Romania and Turkey were granted long-term credits.

Year	Order			CS share in world arms export (in %)	Note
	1	2	3		
1930	Great Britain	France	USA	9.5	4th CSR
1931	Great Britain	CSR	USA	11.1	
1932	Great Britain	France	Sweden	4.0	7th CSR
1933	Great Britain	France	Sweden	8.5	5th CSR
1934	CSR	Great Britain	France	27.0	
1935	CSR	Great Britain	France	24.4	
1936	France	Great Britain	CSR	15.5	
1937	Great Britain	Germany	CSR	11.9	

Reference: Olšovský, R.: World trade and Czechoslovakia, Praha 1960.

Table 1. The leading arms exporters from 1930–1937

After 1939, the entire Czechoslovak aircraft industry was incorporated into the giant concern Herrmann-Göring-Werke and worked for the needs of the Luftwaffe. Also the other branches of the weapon industry worked, after 1939, for the fascists' war plans.

Weapon production from 1948–1989

It may seem paradoxical that the period of the last forty years of Czechoslovak arms production and export is hidden in denser fog than the prewar period. A number of records have not been released yet and it is also a very short time that has elapsed from the former regime, not providing enough time to elaborate upon this topic. That is why we have to rely upon the published magazine articles and uncertain reports from the foreign press. Nevertheless, the picture enables us to have an idea about the development of armament and the importance and main directions of the Czechoslovak arms export.

The weapon production started to grow rapidly. If, in 1950, its volume was 100 per cent, then in 1951 it already made 198 per cent and, two years later even 384 per cent. The share of military production in Czechoslovak mechanical engineering increased from 4 percent (1950) to 27 per cent (1953). It may be worth analysing these data and showing how the defence industry started to assume its superior position. The weapon production in a number of factories was also developed with an assistance of authorized representatives who were in charge of a great part of the engineering branches. The armed forces even intended to build their own metallurgical base in this period.

The first half of the 1950s was characterized by the rearmament and unification of the Czechoslovak Armed Forces' materiel with the Soviet Army. The recovery of the country's defence industry in the postwar period went fully under the guise of the adoption of the Soviet models of military materiel as mentioned above.

Having a detailed look at the decisions on development in the defence industry in the 1950s, we can see that both the Czech and Slovak political representatives were interested in building up the defence industry directly in their regions. The first such important impetus for a development of the weapon production in Slovakia resulted from the resolution of the Central Committee of the Communist Party of Czechoslovakia from February 13, 1954 on provision of special production (based on the requirements to rearm the armed forces).

The mentioned political decision from 1954 set the entire mechanism of building the arms production into motion which started with a considerable relocating of arms production from Bohemia to Slovakia. The relocating was accompanied

with a transfer of experts, too. The build up of the arms manufacturing capacities was mainly governed by the requirements of the Soviet Communist party. Though Czechoslovakia had an advanced defence industry from the past, the Soviet requirements were so high that it could not meet them as it had to ensure the military equipment for its own armed forces as well as the defence supplies for the other countries of the Soviet block.

The buildup of a sizeable weapon-manufacturing base required not only investment but also the high-quality and scarce raw materials for weapon production. In this period the rapidly rising requirements of the defence industry resulted in the reduction of civilian production. The enterprises manufacturing electro technical devices were congested with the supplies for the Czechoslovak armed forces and the Soviet Union.

The arms factories started to differ substantially from the civilian enterprises, primarily because of their demands for capital and structure of manpower. A number of changes can be found in a long-term time series but generally their demands for capital required higher investments in technology and a higher qualification of the work force.

The orientation of the military production towards the Soviet Union led to a development of licensed production which was primarily introduced into newly built arms factories. In the 1950s, the licenses were mostly free while in the 1960s and 1970s the Soviet Union required license fees, which were rather high. Czechoslovakia purchased licenses to manufacture aircraft and tank equipment. The last negotiated license agreement in the period 1953–1990 was a license to produce the T-80 tank.

Besides the licenses to produce the Ground Forces' materiel, Czechoslovakia started to manufacture the following Soviet aircraft: the IL-10, MiG-15, MiG-15bis and UTI MiG-15. In 1957, a small number of IL-10 attack aircraft were exported also to Yemen. The licensed production of the MiG jets meant the breaking point in the Czechoslovak aircraft industry and later enabled there own development and manufacture of aviation materiel. It remains a fact that not always the license production of the soviet materiel was economically more advantageous than the same materiel imported from the Soviet Union. It also refers, for example to the MiG-21 although, at the beginning, no license fees were paid to the Soviet party.

The usual practice was that the license fees were paid according to the number of pieces manufactured. Later, a total single license fee was to be paid.

In addition to the socialist countries, the greatest customer of the Czechoslovak arms factories in the 1950s was Egypt which purchased tanks and also aircraft. The Czechoslovak-made MiGs-15bs were employed in the Suez Conflict. The Czechoslovak tanks and armoured personnel carriers (APC) supported the Egyptian side in the Arab-Israel War in 1967. It was one of the OT 62 APCs, manufactured under the Soviet license in the early 1960s and enhanced by Czechoslovak designers, which was the first one to cross the Suez canal during the Egyptian offensive against Israel in 1973. Then, for a long time the OT-62 APCs were leading the Egyptian troops during military shows.

The OT 62 TOPAS (APCs) were also employed in the India-Pakistan conflict on the Indian side. Pakistan also applied for a delivery of Czechoslovak materiel but was turned down. Czechoslovakia offered Pakistan the creation of complete plants for military production instead, which became an important element of the country's military policy especially from the 1970s. In the 1960s the complete investment plants also represented a great portion of the Czechoslovak exports as well. Exports of military technology was strongly supported in the 1970s.

Period	Import	Export	Balance
1956–1960	5,787	6,642	+ 1,345
1961–1965	11,058	7,481	- 3,577
1966–1970	13,632	14,350	+ 1,318
1971–1975	19,744	19,892	+ 0,191
1976–1980	31,741	33,447	+ 1,706
1981–1985	43,482	45,878	+ 2,416
1986–1989	48,987	58,388	+ 10,601

Table 2. Import and export of weapons and military materiel to socialist countries (in CZK milliard, current prices)

The following table gives the data per single year. These data show absolute volumes of exported and imported weapons in single years. Especially interesting are the data related to the export of weapons to the socialist countries which, from 1960–1990, had a rising trend. This implies that with the worsening of the economic situation more and more military materiel was exported.

Year	Import	Export	Balance
1960	655	491	- 164
1970	1,297	2,119	822
1980	2,994	3,583	589
1988	6,503	7,543	1,040
1990	4,159	4,792	433

Source: Federal Statistical Office, 1991

Table 3. Mutual weapon trade between Czechoslovakia and other socialist countries (in millions of CZK, current prices)

Thus, a development in defence production was primarily focused on fulfilling the orders of the socialist countries. If the volume of production for non-socialist (i.e. developing) countries was 100 between 1956 and 1960, then, in the period between 1981–1985, it was as much as 236.

Compared with the prewar era, many things changed in the postwar period. Czechoslovakia did not succeed to link up to the trade achievements. For a long time, the country lost its independence in decisions about its business partners. It was also due to the fact that a considerable amount of materiel was produced under Soviet licenses and foreign trade with military equipment was influenced by the bipolarity in world policy.

The development of military production was affected by a number of circumstances. These included political and economic factors as well as military influences. Also the technical maturity of the industrial base that supported the production of weapons and military-purpose products should be taken into consideration.

The growth rate of military production, including the manufacture of military-purpose goods, was 42% in the 1950s, 27% in the 1960s and 20% in the 1970s. In the 1980s the dynamics was nearly similar as in the first half of the 1960s.

Changes in the global defence industry after 1989 and their impact on Czech Republic defence industrial base and its future development

Most industrialized countries have recognized the importance of the defence industry a long time ago and those countries decided to establish a government organization which is responsible for the health, capacity for growth, innovation, responsiveness to changes of its defence industrial base.

The whole process is supported by manufacturers selected by state administration. The process is motivated by political and strategic considerations, but it is also influenced by the maintenance of export potential and the competitiveness of traditional domestic manufacturers. The state offers its help in several areas – the conclusion of agreements on the export of weapons systems at government level, support for research and development, etc.

In order to promote stability and the efficiency of production, the government organizes a series of mergers of several manufacturers allowing the defence industrial base to have an adequate structure and desired performance. It is also about maintaining and improving its high technical and technological level.

In France, the process of restructuring the defence sector is under direct and significant state intervention. The collision of wider strategic interests with economic reality, supply difficulties and the challenging development of different types of programs (aerospace, missile and nuclear) means that the process has slowed down. Some issues have not been solved yet – for example reductions and reorganization and probably the necessary merger of weapons manufacturers.

For the basics for solving the problem of the defence industrial base we can consider privatization[1], which is increasingly influenced by groups with political

1 Case of state company GIAT, which almost bankrupted in 1996 because of debts 2,4 billions of USD, shows how needed the privatization is. The state had to intervene and pay debts (3,7 mld FRF - 740 mil. USD) in first step of "emergency plan". The decision was taken under political pressure – the GIAT was employing over 12 500 employees in local 14 manufactures.

interests[2]. In the UK, the process of rationalizing the defence industrial base has been characterized by this, probably, ensuring greatest flexibility. The success of the stabilization of arms production is today ensured by an almost 25% share of the global arms market (with an annual volume of about $ 11.2), coming second place behind the United States (2010).

Direct state intervention in the defence industry in the UK practically does not exist. The interests of the state was implemented through a national strategy to support the defence industrial base, which is a manifestation of such a closure alliance agreement between the State and the Association of British airlines (SBAC).[3] This national strategy defines the main directions of armaments acquisition policy and international cooperation in the field of armaments. We cannot forget the issue of the documents with information about new strategies and analysis of military conflicts.

The relative stability of the defence industrial base is ensured by the fact that private companies are long accustomed to operating in a competitive environment. It is a well managed manufacturing diversification of production, for example the process of pouring military and civilian production, depending on market conditions and changes in demand. Top subcontractors can handle a wide cooperation network. The necessary reduction of the production programs of final producers is the longer-term issues. The final manufacturers form the core of the defence industrial base.

Small countries profit from NATO efforts to optimize the defence industry within a specific field. The new situation in Europe and in the world has meant a definitive end to their inertia with persistent efforts to maximise arms autarky. For a small country it seems that the simple purchase of military equipment abroad (especially large weapon systems) is increasing an economic burden. Today, in a situation of limited defence spending and further rises in costs, modern military technology has become unattainable. This forces small states to decrease the technological level of their military if necessary.

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2 This is noticeable in a case of state company Thomson-CSF and in case of consideration fusion of air companies Aerospatiale a Dassault Aviation.

3 Content is represented by common subvention of research and development and production base of air industry.

This situation led to the escalation of efforts to broaden international cooperation, usual cooperation, co-production and licensed production. At the same time it has developed extensive strategies, payment schemes and financial compensation for amounts spent on imports of major weapons systems (aircraft, tanks, vessels, etc.) of own military and civilian industrial production. The so-called offset operations were and still are in these countries part of the state policy of the acquisition of military technology. The implementation of the offset policy was done by committees that had helped to do it.

Small countries do their best to produce according to the national demand, even on the edge of economic efficiency or even below it. However, there are other reasons than just fear of political dependence, which we considered insignificant in NATO. It is primarily a country's effort to keep running its own manufacturing capacity on critical national defence, but also to fulfil the objectives of economic policy.

It can also be noted that small countries tend to engage in joint international programs. Interesting in this context is a step by Denmark, the Netherlands and Norway to join the U.S. in producing the JSF aircraft, this includes a common share in the funding for this program.

Nevertheless, the crucial steps to optimize the defence industrial base in NATO countries were carried out, it is necessary to look wider in the Euro-Atlantic and global market. This is evidenced by such phenomena as the declining number of customers and decreasing the volume of demand. It is increasingly difficult to maintain acceptable production economy operations (in addition to the technical demands of growth) and the increase in product prices. This situation is forcing manufacturers to take part in common (international) programs organized on a multilateral or bilateral basis. There is nothing extraordinary about joint programs in the sense of self-preservation.

As a result of the relentless rationalization and reduction of production programs (manufactured goods) the total number of producers is (and will) continuing to decrease. For a limited market, there is not the place for a wide variety of quality comparable to the same products. This will gradually force specialization and further expansion of armaments cooperation, in which we promote financially strong and technically proficient manufacturers. This situation, on the one hand,

means for the small and weak producer a loss of opportunities, a loss of place for their production and the narrowing of their own production, especially the decline in production to final extinction. On the other hand, increased competition will result in innovative small companies that have innovative know-how and the ability to access technology programs, with innovative ways of strengthening their market position and obtaining government contracts from for defence and space research.

The arms industry in the Czech Republic went through a complex and dynamic process of transformation. This transformation was influenced by external and internal factors as well.

Speaking about the external factors, we have to mentioned firstly the changes of the territorial forces and influences in Europe, a division of the Warsaw Pact and the Council for Mutual Economic Assistance, a significant decline in military budgets accompanied by a strong wave of reduction of the armed forces, intensifying competition in the defence market and the persistent barriers to entry from outside the nation States.

Considering the internal factors, we can start from a dramatic drop in demand of the Czech armed forces, privatization, a quick stop of production of heavy weapons, a decrease in employment (in some cases up to 80%), growing disinterest of representatives of the government in this part of the economy and a lack of a concept resulting in the fragmentation and subsequent loss of the ability to adequately meet the potential demand.

Around the year 2000, we saw the short-term recovery, which can be illustrated by two major contracts from the Ministry of Defence. It was the purchase of L-159 ALCA subsonic fighters and the modernization project of the T-72 M1. This recovery efforts were related to partially preserving the capacity of national manufacturers and providing space for consolidation. Since 2004, the Ministry of Defence and the Ministry of Trade and Industry are focusing on acquisition, which was accompanied by significant offsets.

Nowadays, the Czech defence industry is characterized by a limited production capacity[4], a significant proportion of civilian production and the ability to develop dual-use technologies. It is competitive on the world market[5] and it has the potential for further development [6].

The Czech Republic has currently 220 companies with authorization for the import and export of military material. In 2012 the government granted a total of 1,220 permits for the import and export of weapons.

Year	Import	Export	Balance
1994	39	172	133
1995	44	136	92
1996	30,5	103	72,5
1997	29,3	161	131,7
1998	38,8	92	53,2
1999	102,3	89,9	-12,4
2000	150,5	86,7	-63,8
2001	113,3	60,5	-52,8
2002	92	77	-15
2003	120,4	82,9	-37,5
2004	125	89,7	-35,3
2005	726	88	- 638
2006	92,7	93	0,3
2007	193	174	-19
2008	106,7	189,6	82,9
2009	179,6	179,6	-4,5
2010	376	217	49,4
2011	238,2	183,4	-54,8

Source: Annual Report MIT 2012. http://download.mpo.cz/get/35863/52477/591018/priloha001.pdf.

Table 4. The evolution of imports and exports of military stocks in the Czech Republic from 1994–2011 (mil. €, current prices)

4 We can speak about loss of ability to produce the most important major conventional arms, as a result of separation of Czechoslovakia and transformation.

5 Actual military exports are much different than the sale in late 80s and early 90s, but the decrease in sold outcome is visible. The reduction is dealing with areas, where Czech military manufacturers have strong position and we should expect maintain of positions.

6 According to the declamation of president of Association of defense and security industry, Mr. Jiří Hynek, the economic recession does not have serious impact on industry, because of long terms contracts.

This relatively favourable position presupposes a radical change of attitude of the government, the Ministry of Defence and other central state administration assets to the defence industry. It is dealing with the optimization of the acquisition process, increased awareness of and campaigning for start-up companies in the field of research and development and creating space for the presentation of their production abroad. An essential step of the government program is represented by a conceptual defence industrial policy, which would be a meaningful part of state policy.

Conclusion

The new point of view on armed production has to respect five different perspectives:

- the consequences of changed geopolitical, security and military environment influences the choice of military equipment,
- the consequences of a decreasing military budget,
- externalities, which take basis in expenditures on research and development and the existence of defence industrial base (spin-offs),
- the current and possible influence of military production on industrial competitiveness of economy,
- current conditions and the possible future of defence industrial base.

How can we imagine the future of the defence industrial base in the Czech Republic? It will be surely influenced by the situation on the global defence market and also by many other factors. Factors from outside the market, which influence the Czech defence industry, are mentioned below:

- limitation and following restriction of offsets in defence businesses,
- the realization of collective international development and acquisition programs[7],
- the consolidation of defence industry – the realization of other horizontal or vertical fusion of companies specialized in armed production.

7 Those programs should fulfill expectation dealing with time schedules, expenditures, risks, management and capacity of programs.

Factors, which will influence the defence industrial base in the Czech Republic are connected to the basics of the industry, but also to the government's decisions. We consider the following factors:

- the ability of Ministry of Defence to behave like an institution minimizing expenditure,
- the conception of politics, which consider necessary the defence industrial politics,
- the ability of government to finish the privatization of the defence industry, which is partly or completely owned by the state,
- consolidation of the defence industry, the continuing fusion of the defence industrial base,[8]
- the ability of companies to do their own research and development, especially the development of technologies of double use and technologies with a high added value,
- the ability of companies to fulfil demand, which exists because of new requests in the security environment[9].

Except for existing factors, we should consider the influence connected to the role of the defence industrial base in potential current conflict. This role could be represented in different areas – from maintaining control, sporadic production, accelerated acquisitions in planned programs, to the modification, development and production of new armed systems. Modern defence industrial politics should respect possible roles and for them what is adequate is to create conditions.

From the arguments mentioned above we should conclude that the defence industrial base is an inseparable part of the national economy and it should be cultivated as a functional part of securing the economy during danger or conflict. Those roles were respected in the years 1918 – 1939, also in conditions of the socialist system in Czechoslovakia, and they should be respected in current times, even in the future.

8 This factor is important to overcome significant fragmentation of defense industry manufacturers.

9 New areas on defense market are created by new demands on innovation in technology, especially in cyber security, control, reconnaissance flies, military robotics and data transmission, which offer opportunities for Czech companies as well.

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SECURITY AND DEFENCE – HISTORICAL PERSPECTIVE

THE „CANON PROVIDER" STARTS HIS CAREER – GENERAL JÓZEF DWERNICKI AND THE CAVALRY BATTLE AT STOCZEK (14 FEBRUARY 1831)[1]

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„To arms! To arms! The Russians are killing us!" Junior army officers and college students raced through the streets of Warsaw shouting these words on the night of 29 November 1830. This was the start of the *Noc listopadowa* (November Night), and included fires, assassinations, street fighting, and tremendous confusion for the Kingdom Of Poland.[2]

A compromise resulting from divergent needs of great powers at the Congress of Vienna, it was an autonomous part of the Russian Empire from 1815–1830. This marriage between Poles, whose political traditions stressed limits on royal authority, and Russians who lived under Romanov autocracy, was at the best, a challenging relationship. It might have worked as Tsar Aleksandr I had a reputation for reform, and an interest in constitutions. Unfortunately he drifted off to mysticism after 1816, allowing General Aleksey Arakchevyev to initiate policy. So Russia chaffed under the *Arakcheevschina*, while stress was also evident in the

1 Drs. Michał Kopczyński and Jarosław Czubaty from Uniwersytet Warszawski and Dr. Bolesław Orłowski from Instytut Historii Nauki PAN, provided valuable advice and bibliographic assistance. We also appreciate Łukasz Sobechowicz and his friend Ariel, who took us to visit the Stoczek battlefield. The good was made better by their collective help; the bad remains the sole property of Bartos and Dunn.

2 For more on the „November Evening," see John Dunn, „The November evening': The Warsaw uprising of November 1830," in Journal of Slavic Military Studies Vol. 16 (2003) No. 3: 126-135.

Kingdom of Poland.[3] Thaddeus Kościuszko, who had fought with the Americans against George III, then returned home to direct the 1794 uprising, complained to Thomas Jefferson on 1 April 1816, „...a constitutional government, liberal and independent, plus the liberation of our wretched peasants...all disappeared like smoke."[4]

The „hero of two nations" would have found Aleksandr's brother, Nikolai I, equally disappointing. Reacting to the Decemberist mutiny that sought to halt his 1825 coronation, the new Tsar and King of Poland clamped down on dissenters. Police raids, censorship, exile or long prison sentences exacerbated anti-Romanov opinions among Polish notables. Historian Norman Davies asserts, „It was Nicholas I who turned even pro-Russian conservatives into active rebels."[5] Nikolai, who viewed rebels as „...a species of animal between man and beast, something undesirable and unfortunately, all too real," cared nothing for the opinions of the intelligentsia, and continued to stamp out dissent, at home, and in the Kingdom of Poland.[6]

Then, as General Klemens Kołaczkowski remembered the summer of 1830, news of French and Belgian revolutions „...fell on Warsaw like a lightning bolt."[7] Highly flammable junior officers, university students, and disgruntled artisans, needed but a single spark to get red hot, and the government provided such with orders to mobilize the Polish Army for restoring the European *status quo*.[8]

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3 Artilleryman and martinet, Aleksey Arakcheyev was Aleksandr's favorite. Schnitzler said he „...joined the crafty severity of the priest to the sombre [sic]cruelty of the oriental vizier." J. H. Schnitzler, Secret History of the Court and Government of Russia (London: Bentley, 1847), Vol. I, pp. 383-384.

4 Cited in Jacek Jedruch, *Constitutions, Elections and Legislatures of Poland, 1493–1993* (New York: Hippocrene Books, 1998), pp. 211-212. See also Harold Nicolson, *The Congress of Vienna: A Study in Allied Unity, 1812–1822* (Grove Press, 2001), pp. 172-179.

5 Norman Davies, God's Playground: A History of Poland, 1795 to Date (Columbia University Press, 2005), Vol. II, p. 238.

6 Cited in Nicholas Riasanovsky, *Nicholas I and Official Nationality in Russia, 1825–1855* (Berkeley: University of California Press, 1959), p. 229, n. 89.

7 Klemens Kołaczkowski, *Wspomnienia Jenerała Kelensa Kołaczkowskiego* (Krakow: Spółka, 1901), vol. 3, p. 133.

8 Wacław Tokarz, *Sprzysiężenie Wysockiego i Noc Listopadowa* (Warsawa: MON, 1980), p. 69. See also Marek Tarczynski, „Le Rôle de l'Armée dans le Développement Social de la Pologne dans les Années 1807–1831," in Eugeniusz Koz/owski, *L'Armée aux Époques des Grandes Transformations Sociales,* (Varsovie, 1980), pp. 44-45.

The November Evening, despite a dose of Clausewitzian friction, tossed Romanov authorities out of Warsaw, or assassinated them on the street like General Maurycy Hauke, whose body featured 19 bullet holes. Eyewitness Roman Sołtyk explained this was „...the prompt and terrible justice of the people."[9] Nikolai, whose brother Konstantin barely escaped a similar fate, was enraged. When the conspirators were revealed as junior officers and academics, with no long term plans, conservative nationalists took control and attempted to negotiate a settlement with the Tsar. His only offer was clemency in exchange for complete surrender. This was not acceptable to Warsaw, and so the November Night morphed into the November Insurrection – a full-fledged war between Poland and Russia.[10]

A war between the Kingdom of Poland, which was smaller than the Napoleonic Grand Duchy of Warsaw, and the Russian Empire seems ludicrous and many Russian and not just a few Polish generals from 1830 shared this impression. Yet it turned out to be a hard fought campaign, one that taxed Russian resources, revealing, as the Crimean War did on a grander a scale, that the army of Nikolai I was far from perfect. [11]

It was a military machine trying to serve too many masters. Massive parades featuring complex drills that had little purpose on the battlefield were one trademark, along with cruel discipline as well as a demand for blind obedience. Then there were the military colonies, where the state attempted to create agricultural centers run by soldier-farmers, but ended up with the worse of both worlds. Tsardom also needed many soldiers for internal security and to protect

9 Roman Soltyk, *La Pologne. Précis Historique, Politique et Militaire de sa Révolution*, (Paris, 1833), vol. I, pp. 62.

10 „Chłopicki to Nikolai, Warsaw, 10 December 1830,"in Michał Rostworowski (ed.), *Dyaryusz Sejmu z R. 1830–1831*, (Cracow, 1907), vol. II, pp. 180-182. Nikolai, in a note reproduced on p. 187, responded that clemency was possible, but any further negotiations were „...an unpardonable weakness and needless on my part." Only a few English-language monographs cover the November Insurrection: S. B. Gnorowski, *Insurrection of Poland in 1830–1831 and the Russian Rule Preceding It Since 1815, (*London, 1839); Józef Hordynski, *History of the Late Polish Revolution and Events of the Campaign,* (Boston, 1833) and R. F. Leslie, *Polish Politics and the Revolution of 1830*, (London, 1956).

11 For an excellent introduction, consult John S. Curtis, *The Russian Army Under Nicholas I, 1825–1855* (Duke University Press, 1965). See also Frederick W. Kagan, *The Military Reforms of Nicholas I* (New York: St. Martin's Press, 1999), who argues Nicholas learned from failure, and established traditions that allowed for a much better Russian Army in the 1869s/70s.

the frontiers from disgruntled rivals like Iran or the Ottoman Empire; neighbors defeated by Russian arms in 1828 and 1829. Cholera was about to kill over 100,000 Russians, and the army was needed to man quarantine stations.

Under these circumstances, they performed better than expected. Nikolai's soldiers demonstrated courage and perseverance securing victories in the Caucasus and Balkans, but also exposed problems in training, marksmanship, plus logistical defects. They also lacked reserves, mainly from the state's exclusive reliance on serfs to fill the enlisted ranks. This in turn demanded Russia keep a massive standing army; 800,000 men in 1816. Assignant rubles could paper over this problem for awhile, but their decline in value in relation to gold was astronomical in the early nineteenth century. Perennially short of funds, this made it even easier to avoid costly training exercises, especially if these might conflict with the Romanov mania for parades.[12]

The Russian soldiers poised to invade Poland were trained to fight by the book, move ponderously, favor the bayonet over musketry and above all, avoid initiative. The writers' favorite example of Russian generals' excessive zeal for following regulations comes from 1831. At the start of the campaign, a large group of cavalry was stopped by a Polish infantry company holding a bridge. Hours went by before a Tsarist infantry unit arrived. Even though several regiments could have dismounted, and employed carbine fire to dislodge the bridge guard, this was not attempted as regulations said nothing about fighting dismounted, and advised against charging infantry guarding a bridge![13]

This is not to say that all advantages lay with the Poles. Russian armies were much more numerous than the opposition, who never fielded more than 60,000 troops. Their gunners were very good, cavalry numerous, and the infantry, even if unimaginative, were steadfast. Their record fighting Bonaparte in 1812–

12 Kagan, *Military Reforms...,* pp. 10-12, 15. See also Alexander Britts, „Reserves under Serfdom? Nicholas I's Attempts to Solve the Russian Army's Manpower Crisis of 1831–32," in *Jahrbücher für Geschichte Osteuropas* Vol. 51 (2003) No. 2: 185-196; and Alan Ferguson, *The Russian Military Settlements, 1810–1866* (Yale University Press, 1953).

13 John S. Curtis, *The Russian Army...,* p. 134.

1815 was certainly impressive, and as Frederick the Great put it…"It is easier to kill Russian soldiers than to defeat them."[14]

Russian problems played out from the very start of the November Insurrection. Crushing the revolution quickly required mobilization of armies in White Russia and Lithuania. Invading via the Ukraine might have been easier except those troops were recovering from service against the Turks in 1828–29. Commanding the invasion was Hans Karl Friedrich Anton von Diebitsch. One of many foreign officers in Tsarist service, he joined the Semenovsky Life Guard Regiment in 1801, fought in most of the campaigns against Bonaparte, and through a combination of zeal and bravery, was major general by 1812. His successful campaign against Turkish defenses in the Balkans provided noble title and promotion to Field Marshall.[15]

Diebitsch, directed 114,000 men in eleven separate columns for an invasion of Poland. Expecting little resistance, he gave but three weeks to cross the Bug River at Nur, march on Warsaw, then crush the rebellion. Recent bad harvests, plus lack of funds reduced his army's bread and meat rations by half, and allowed but two cups of vodka per week! Not a good start as slow moving infantry marched through cold weather on a poor road net.[16]

Then nature turned against Diebitsch. Common knowledge holds that „General Winter" serves in the Russian Army, but he must have been AWOL in February 1831, when temperature went from -22° C to 4° C in the space of a week, creating an early thaw. This was disaster of the Field Marshal's strategy, which counted on frozen ground for more rapid movement. Now the regions many rivers, streams,

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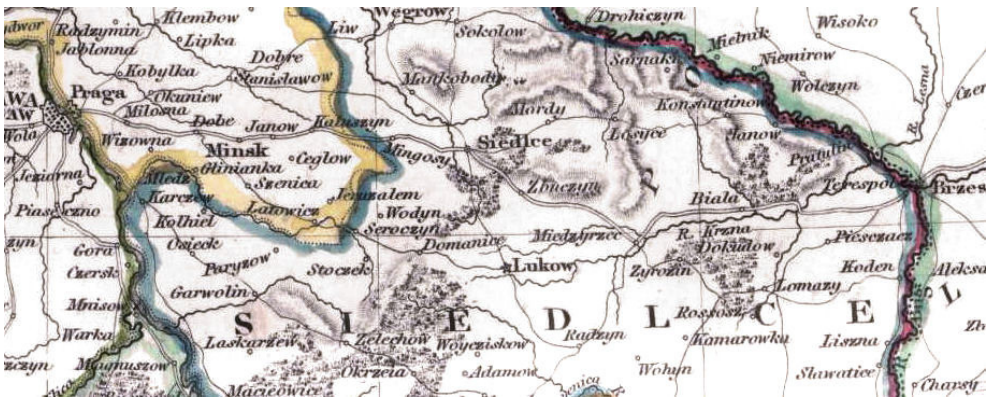
14 Cited in H. M. Scott, The Emergence of the Eastern Powers, 1756-1775 (Cambridge University Press, 2011), p. 49.

15 Russians called him Diebitsch „Zabalkansky" for his success against the Turks. See Belmont [pseud. Heinrich A. Schuemberg], *Hans Carl Friedrich Anton, Graf von Diebitsch-Sabalkanski, kaiserl. russischer Feldmarschall, neben Russlands vorzüglichsten Feldherren; nach mitgetheilten Familien-Nachrichten dargestellt*, (Dresden: Arnoldischen, 1830).

16 A. Puzrevskii, *Wojna Polso-Rossyjska 1831 Roku*. Trans. P. J. Bykowski (Warszawa: Tygodniowego, 1888), p. 41. Written by an eminent military historian and member of the Imperial General Staff, this work came out in several Russian and Polish editions, along with a German translation. Still one of the best histories to date. His Polish counterpart, who served as Quartermaster-General during the revolt also produced a superior, albeit sometimes opinionated history. Ignacy Prądzyński, *Pamietnik Historyczny i Wojskowy o wojnie Polsko-Rosyjskiej w roku 1831* (Petersburg: K. Grendy-Szyńskiego, 1898), Vol. I, pp. 28-29.

ponds and marshy grounds dramatically reduced the rate of march, or eliminated options by now impassible terrain. Compounding the issue, there were still plenty of ice floes to make river crossing longer and dangerous, while cold-damp weather dispirited the invaders. The Russian advance had to focus on the Brest to Warsaw road. This required diligence as first the Russians had to cross the Bug, which could provide Polish commanders with a chance for mischief against partially deployed units.[17]



Source: Poland Map, Society for the Diffusion of Useful Knowledge, London 1832.

Map showing Stoczek's place in relation to the Brześć to Warsaw road

Working from interior lines, Poles could strike isolated Russian units, or raise partisan forces to attack Tsarist supply columns. Diebitsch had to proceed with caution, but not too slowly, as every extra day allowed the rebels to mobilize more soldiers who were based in well-supplied towns, while Russian troops lacked shelter and were rapidly consuming their rations. As his hungry men requisitioned food from local farmers with little to spare, this made it guerilla actions even more likely, forcing Diebitsch to deploy garrisons to protect his rear.[18]

On 9 February, the Field Marshal created flank guards to cover his main force on the Brest-Warsaw road. The Second Cavalry Division, commanded by General

17 Puzrevskii, *Wojna Polsko-Rossyjska...,* pp. 28-29. See also Józef Hordynski, *History of the Late Polish,* pp. 91-93.

18 John S. Curtis, The Russian Army, pp. 77-78; Puzrevskii, *Wojna Polsko-Rossyjska...,* p. 38.

Friedrich Caspar von Geismar scouted to the south and finding no enemy forces, dispersed to search for partisans, supplies, and to find shelter for men and horses. These actions helped generate the first major battle of the November Insurrection.[19]

Von Geismar was part of a tightly knit German cadre that held considerable influence in the early Nineteenth Century Russian Army.[20] Born in Westphalia, he served in Austria's elite *Deutschmeister* Infantry Regiment, then transferred to Russian service in 1805. By 1813, he was a colonel commanding a Cossack Regiment. Back in Russia, Geismar crushed the last of the Decemberist rebels at Kovalivka (15 January 1825), but it was triumphs against the Turks in 1828–29 that secured promotion to Lieutenant General.[21]

Source: 19th Century Print, John P. Dunn Collection

General Dwernicki from a contemporary print

A very different Napoleonic veteran was about to cross swords with von Geismar. Józef Dwernicki started his military career as an artillery cadet right before the Polish-Lithuanian Commonwealth was gobbled up by Austria, Prussia, and Russia. Joining Bonaparte's Polish army in 1806 he converted into a dashing cavalry leader, and was promoted to colonel for his skillful rear guard actions at Leipzig (1813). His military career continued with the Kingdom of Poland, where he wrote new cavalry regulations and made brigadier general in 1829. A portly fellow known for his love of fine food and spirits, Dwernicki also maintained excellent rapport with his troopers, and even the horses, who „...saved him from death several times."[22]

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19 Puzrevskii, *Wojna Polsko-Rossyjska*, p. 46.

20 Germans, Austrians, Swedes, French Émigrés, and British officers served in the late 18th to early 19th Century Russian armed forces. The Fanshawe family produced three generations of Russian generals! „Englishmen in Russian Service. The Fanshawes," in *The United Service Magazine*, Vol. 51 (May 1846): 85-86.

21 Russian sources call him Fedor Geismar Klementevitch. Friedrich Caspar von Geismar, *Biographie des Generallieutenants Reichsfreiherrn Friedrich Caspar von Geismar, General der Cavalerie, Generaladjutant Sr. Maj. des Kaisers von Rußland* (Munster: Druck und Verlag der Theissing'schen, 1860).

22 Józef Dwernicki, *Pamiętniki* (Lwów: Nakład i wydanie staraniem L. Plagowskiego, 1870).

Dwernicki and his fellow generals faced several challenges in January/ February 1831. It was obvious Diebitsch was moving on Warsaw with superior numbers. The rebel government, hoping to negotiate a settlement, refused to consider a preemptive strike and was slow to raise more troops. The tsar's refusal to offer concessions forced Polish leaders to authorize the draft of veterans and call for volunteers, but many of the new units needed training and lacked useful weapons.

Polish tradition held that in place of muskets, infantry could use scythes converted into pole arms. The architect Chrystian Piotr Aigner even produced a booklet on the subject, *Krótka nauka o kosach i pikach* (Short Treatise on Pikes and Scythes), and called for more units of *Kosynierzy* (Scythmen). This was right after peasant volunteers armed with scythes helped win the 1794 battle of Racławice. By1831, these *Kosynierzy* were unlikely to produce victory. As General Ignacy Prądzyński put it, „...as for scythes or spades, this war proved once again that they were nothing compared to muskets and bayonets."[23]

Kosynierzy participated in only two major battles of the November Insurrection. Volunteer cavalrymen however, the *Krakus*, served in nearly every clash. Good horsemen, mainly equipped with sabers and a sprinkling of firearms, they formed 500–800 man regiments and were valuable assets on an 1831 battlefield.[24]

Both weapons and the tactics designed to make them effective, were dramatically different in 1831. Smart commanders made their infantry, artillery and cavalry worked as a team, but due to the limitations of command and control, packed troops together in close formations. Firepower came from massed bodies shooting in volleys. This same body was an easy target for the opposition, and victory was often a matter of reloading one-shot muskets as rapidly as possible. Save for the Finnish Guard Jager Battalion, in 1831, not a single unit had rifles. Instead, cavalry used pistols or short barreled carbines, with longer muskets for the infantry – all smoothbore. The post 1815 Russian army placed excessive value on fancy footwork for parades, and paid little attention to marksmanship beyond weapons

23 Ignacy Prądzyński, *Pamietnik Historyczny*, vol. I, p. 22. Scythes were still used by Polish rebels in 1863; their American counterparts considered issuing pikes to Confederate companies short on muskets.

24 Ignacy Prądzyński, *Pamiętnik Historyczny*, vol. I, p. 30.

familiarization. The results were slow firing soldiers with weapons unlikely to cause severe casualties beyond 100 yards. Against opponents who could shoot faster, like Polish regulars, or move rapidly, like *Krakus*, torpid Russian columns could suffer painful stings.[25]

Cavalry battles, the forte of Geismar and Dwernicki, had their own special rules. Mounted troops were split into several categories. Ulans (lancers) usually had small nimble horses, and although their primary weapon gave them considerable reach, were designed for attacking flanks, plus scouting and skirmish warfare. Chasseurs rode larger horses, carried carbines and sabers and were deployed as battle cavalry. Cossacks, only found in the Russian army, made excellent scouts and could guard supply lines, but had little staying power on the battlefield.[26]

When rival horsemen attacked, there might be pistol or carbine fire, but bullets fired from smooth bores on a moving horse, were unlikely to hit unless discharged at point-blank range. As all were single-shot weapons, once fired, reloading was next to impossible during combat. An 1831 mounted clash was far more likely to be determined by cut and thrust weapons. They might not kill vast numbers of men, but some casualties, combined with a sense that enemy troopers were getting the upper hand, could rout a force off the battlefield. Horse size also played a part, heavy units like chasseurs sat on large horses, and a charge by such might smash through lines of ulans. Conversely, in an extended skirmish, ulan horses were easier to maneuver and had better endurance. Noted cavalry expert Captain Louis Nolan argued heavy horses seldom paid off as „...history proves them to be more formidable in appearance than in reality."[27]

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25 Robert Bruce, et. al., *Fighting Techniques of the Colonial Era, 1776–1914* (New York: St. Martin's Press, 2009) is a useful introduction.

26 Louis Edward Nolan, *Cavalry. Its History and Tactics* (London: Bosworth and Harrison, 1860) is available online. Captain Nolan provides an excellent, albeit highly opinionated look at period cavalry tactics.

27 Nolan, *Cavalry*, p. 64.

Ulan against Cossack by Wojciech Kossak (1900)

Ulans also gained an initial advantage from their weapons system. Lance heads focused the mass of horse and rider onto a narrow point that was guaranteed to penetrate even armor. Successful lance strikes would kill or seriously injure enemy riders or their horses. They were long enough to hit ground targets and even strike at infantry in defensive squares. Ulan tactics called for the riders to strike, ride through the enemy, then return, building up speed for another strike. Opponents armed with swords would strive to keep in contact, for ulans were at a disadvantage in extended hand-to-hand combat.

Good cavalry commanders were like modern fighter pilots, highly skilled, and aggressively pugnacious. Their situational awareness was not only familiarity with local terrain that could enhance offense or defense, but also ploughed fields or marshy soil that might pull off horseshoes, disabling mounts. Cavalry officers had to make the right decision quickly. Move at a trot to save horses' stamina, or order a charge to more rapidly cross ground and avoid extra volleys from reloading infantry or artillery? Save a few squadrons for a reserve, or send them all in to

overwhelm the enemy line? Cavalry's speed required very rapid answers, and woe to the general who picked wrong, for his opponent would not. Do everything just right and your side had fresher horses, which could produce that last spurt of energy needed to turn a flank and possibly end the battle.

Battle of Stoczek by Jan Rosen (1890)

General Geismar understood these rules, but was also aware of what cold damp weather could do to both horses and men. His orders called for covering the army's immediate flank, dispersing partisans and gathering intelligence. Although his troopers fought minor skirmishes several times, reports from his Cossacks revealed no significant threats. On 11/12 February, Geismar dispersed his regiments into the many small villages near Seroczyn. Allowing his men to rest under shelter, while providing fodder for their mounts, made good sense considering the climate. He threw out patrols, creating a trip wire to warn of enemy actions.[28]

28 Ignacy Prądzyński and A. Puzrevskii provide excellent details on the battle of Stoczek. A nice well illustrated modern account is Tomasz Strzeżk, *Stoczek - Nowa Wies 1831* (Warszawa: Bellona, 2010). See also M. Kopczyński, *Bitwa pod Stoczkiem* (Warszawa, 2006); Dariusz.Małyszek, *Bitwa pod Stoczkiem 14.11.1831* (Lublin, 2007); B. Pawłowski, Stoczek (Lwów, 1934). Sadly, Hordynski, a cavalry officer, and the only primary source in English, gets some of the battle confused with Polish actions against General Kreutz a few days later.

In response, Poles were simultaneously massing for the defense of Warsaw, seeking information and hoping to upset Russian plans. Cavalry was the tool for both possibilities, and Józef Dwernicki was the man to command such a venture. He took 14 cavalry squadrons, a mix of ulans and chasseurs, three infantry battalions, and a battery of horse artillery. They crossed the still frozen Vistula, only after personal inspection by Dwernicki, and advanced to Mniszew, about 50 kilometers south of Warsaw. His orders provided considerable leeway, and he took this to mean he could hunt for isolated Russian parties and destroy them.

The Russians near Seroczyn became his target after locals reported their presence. They were spread out, and just far enough from Diebitsch, that a fast moving cavalry action might succeed before reinforcements could intervene. Dwernicki assumed there were a few hundred Russian troopers at the village of Stoczek (today Stoczek Łukowski). He arrived in the morning, but found the village empty.[29]

Dwernicki's surprise attack was foiled by scouting Cossacks who took one of his men prisoner. Cavalry battles ranged from the massed charge by brigades, or even divisions, to skirmishing patrols. The latter might not produce stirring pictures or epic poems, but they did gather intelligence, of which prisoners were the gold standard. In this case, Cossacks raced back to Geismar, and he was able to pull two squadrons from Stoczek, while organizing his division for combat.[30]

Photo taken by Dunn at Stoczek Pomnik in June 2013. It gives a good sense of the very thick nature of local forests, even if they were not very green in February

29 Puzyrevskii, pp. 47-48.

30 Wacław Tokarz, *Wojna polsko-rosyjska 1830 i 1831 r.* (Warszawa, 1993), pp. 167-170.

Now it was Geismar's turn. For an aggressive general with a cavalry division, who underestimated the value of Poland's regular army, attack was his only thought, but the terrain between Seroczyn and Stoczek rendered the task difficult to execute. It was marshy ground mixed with thick belts of trees, sometimes replaced by low hills, and offering only two roads. Infantry could have crossed in between, but Russian chasseurs on their big horses would find any cross-country venture extremely difficult to impossible, and very wearing on the animals.[31]

Gesimar, confident a show of force would brush aside Polish resistance, opted for two attack columns, each supported by artillery. Both were to hit Stoczek simultaneously, but in the era before chronometers, combined with the lack of good maps, this was impossible to guarantee. Thus one column, a chasseur regiment supported by four cannon, left via the north road under Major General Aleksandr Paszkow, whose military career stretched back to 1804, all in mounted service. They traveled along a narrow trail through dense forests and had to cross a branch of the Świder River. Confined to this narrow approach, Paszkow's troopers formed a long column, and would require time to spread out into battle lines.[32]

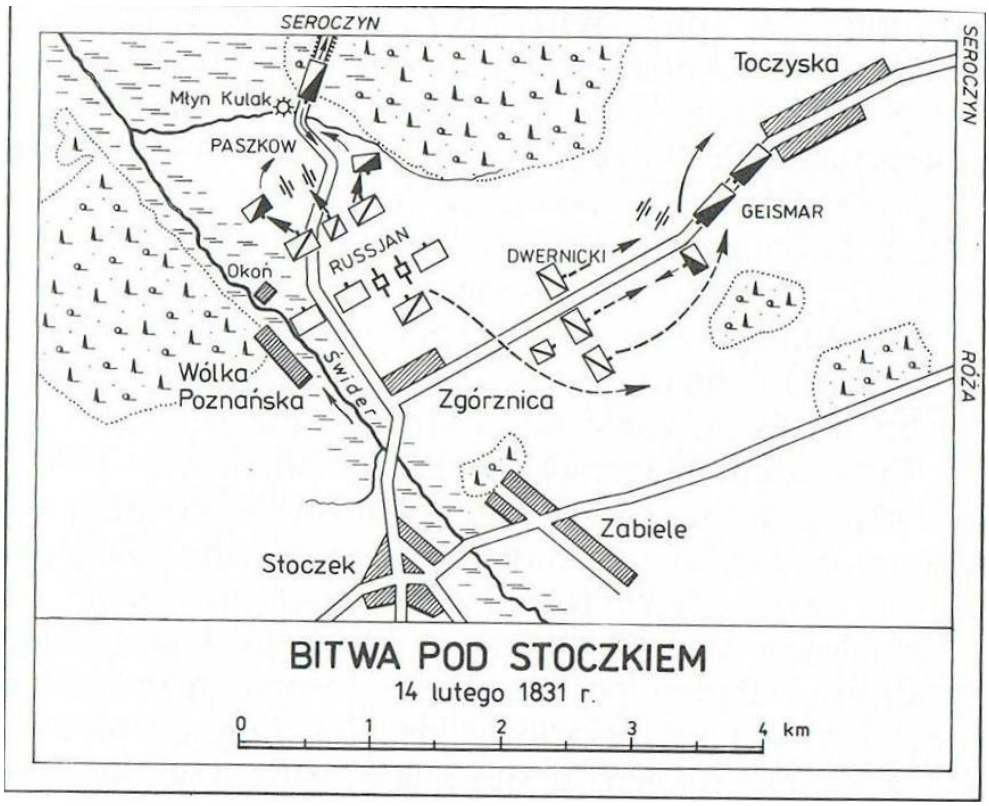
A second chasseur regiment under Geismar, with six guns, took the road to Toczyska, and from there it was open, but uneven terrain to Stoczek. The deployment of the remainder of his division was problematic as there simply was no room to bring it along; a cavalry regiment, followed by an artillery battery, was a long column. Thus Geismar not only left half of his command at Seroczyn, but split the other half between himself and Paszkow. Before modern readers castigate, they might recall that cavalry victories went to the commander who could execute swift and forceful attacks. The Russians were not only confident this would happen, but also expected at least one column would have excellent chances of hitting their enemies in the flank. Under these circumstances, and considering terrain limitations, Geismar's plan makes sense.[33]

Dwernicki's scouts, along with reports of local peasants, guaranteed there would be no surprises. Still he faced a challenge, how to deploy his command for battle.

31 Pradzyński, vol. I, pg. 27.
32 Puzyrevskii, p. 48.
33 Ibidem.

He had thirteen squadrons of highly trained regulars, some of the best cavalry in Europe. Then there were the six guns and three infantry battalions. The latter were a mixed bag, not all that well armed, and in some cases, new recruits.[34]

The Poles had crossed the Świder, and deployed about the village of Zgórznica. The settlement currently consists of only a few hundred people, which might explain why even though the battle was fought in front of Zgórznica, it is named after Stoczek. The village covered both roads used by the Russian columns.[35]



Source: Clipping file, John P. Dunn Collection.

Map of the battle of Stoczek

34 Pradzynski, vol. I, p. 34.
35 Tokarz, Wojna (1993), pp. 167-168.

Placing his artillery on a hill that could cover these roads, Dwernicki backed them up with infantry on both flanks. This was his anchor, and the infantry were expected to defend the gunners, who would be free to attack enemy troopers, or conduct counter-battery fire. At the bottom of the hill, so as not to mask their artillery, Major Franciszek Russyan formed a line of ulans. A veteran of the Napoleonic Wars, his position was designed to attack any units exiting the road from Seroczyn.[36]

Eight chasseur squadrons lined up on the east side of Zgórznica. Elevations, some upwards of 174 meters, provided reverse slopes to hide them from plain view. A Krakus and two ulan squadrons formed Dwernicki's reserve – stationed immediately behind his guns.[37]

Paszkow started the battle early in the morning of 14 February. Polish artillery opened up on Paszkow's chasseurs, who had trouble forming lines due to gullies, trees, and marshy soil. This was painful, three Polish guns were 10-pounder licornes, hybrid gun-howitzers; the others regular three and six-pounders. This combination fired explosive and solid shot, resulting in a heavy fusillade on the Russians that made it even more difficult to transform from column to line. Despite all, Paszkow got two squadrons deployed, and his guns laid out between them.

Then Russyan sent his squadrons forwards before the Russian guns were completely set up, and enjoying considerable advantage in numbers had good expectations for victory. Russyan's charge slowed as his ulans went uphill, and at this point Paszkow made his last mistake. Russian chasseurs on their big horses were mainly designed for close combat. Charging downhill saber in hand, they would have a mass and momentum advantage over the smaller ulan horses. Instead, Paszkow ordered his men to fire their carbines. A good volley could have broken the ulans' charge, but poorly trained marksmen firing downhill from horseback needed to wait for point-blank range. The Russians fired too soon, and although Russyan was wounded, most shots missed. Then the ulans struck hard, spearing enemy horsemen and completely disrupting their deployment. The Russians fell back in such disorder, some unfortunate troopers fell into a pond, where both horses and

36 Puzyrevskii, pg. 47-48; Richard O. Spazier, *Historja powstania narodu polskiego w roku 1830 i 1831*, (Paris: J. Pinard, 1833), Vol. II, p. 26.

37 Puzyrevskii, pp. 47-48.

riders drowned. Others ran through the artillery, insuring it would not have time to re-attach caissons for escape.[38]

Geismar came just in time to save Paszkow from complete destruction. His men had far better ground for deployment, and his six guns quickly started to batter the Polish infantry. Formed in dense formations to repel cavalry attacks while protecting their own artillery, they were perfect targets for Geismar's artillerymen. Casualties piled up, as Polish counter-battery efforts failed. Dwernicki realized he would not win a gun duel, and opted for a cavalry offensive instead.[39]

He sent orders to Russyan to pull back and engage Geismar, then shouting *„Naprzód, stępem marsz*!" (Forward at the trot), threw Polish chasseurs at the enemy. Next he took the reserves, and directed them in a flank attack. The result was Geismar's men getting hit on three sides. This final charge was the stuff of legend, with ulans skewering opponents on both flanks, while Dwernicki's adjutant cut down the Russian regimental commander. Geismar showed great courage, racing into the front ranks, attempting to rally his troopers. It was too late, and only excellent horsemanship kept him from capture or death. His retreating troopers carried many of the gunners' horses with them, so again the artillery was left behind.[40]

The Battle of Stoczek probably lasted thirty minutes. Dwernicki wisely kept his men in hand, as charging down the narrow roads to kill fleeing Russians could have set them up for the same problems that bedeviled Paszkow. Polish horses had also thrown lots of shoes in the muddy soil, and if not fixed, they could quickly go lame. Dwernicki listed 34 deaths at Stoczek, in exchange for 400 Russian troopers killed, 230 prisoners, and 10 captured artillery. No doubt every discarded saber, carbine and cartridge box were also picked off the battlefield. Russian sources admit to 280 casualties and eight guns lost at Stoczek, but General Andolenko admits the defeat created *„...un retentissement considérable*."[41]

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38 Puzyrevskii, p. 49, notes Geismar's chasseurs had just been issued lances, but with no time to train, had left these back in Russia. Spazier, *Historja powstania...,* Vol. II, p. 27.

39 Pradzynski, vol. I, p. 34; Puzyrevskii, p. 48; Spazier, *Historja powstania...,* Vol. II, p. 27-28.

40 Chłapowski, p. 11; Puzyrevskii, pp. 48-49; Soltyk, Vol. I, pp. 298-299.

41 Two guns were left behind for want of towing gear. Général Andolenko, *Histoire de l'Armee Russe* (Paris: Flammarion, 1967), p. 229; Brzozowski, p. 44; Neyfeld, p. 189; Pradzynski, vol. I, p. 34; Puzyrevskii, p. 48; Theodor Schiemann, [ed. and compiler], *Erinnerungen von Alexander Lwowitsch Seeland aus der Polnischen Revolution von 1830/31* (Stuttgart: F. G. Sotta'schen, 1894), Vol. II, p. 95.

Geismar lamented Stoczek as „...the unluckiest day in my life."[42] Losing parts of two regiments, even worse artillery, were great embarrassments. Still, Geismar had enough men and cannon remaining to fight Dwernicki another day. Diebitsch's flank was not uncovered, and so from a tactical point of view, Stoczek was no calamity for Russia. On the political side, however, it was significant. This was the first major battle of the war, and Dwernicki's victory significantly increased morale back in Warsaw, where locals feared the approaching juggernaut. It was a revolutionary Valentine of the first order, delivered by Poland's number one ulan!

Despite limited rations, climate and Stoczek, Diebitsch got his men to the outskirts of Warsaw on 25 February and initiated the Battle of Olszynka Grochowska. Western sources often call it Grochow, but however you spell it, this was the largest European battle between Waterloo (1815) and the Crimean War (1855). This time it was Poland's infantry and artillery, including an innovative rocket battery, that played critical roles. Both sides suffered heavy casualties, and tactically it ended a draw. Strategically, it was a Polish victory. Warsaw, the nerve center of the revolution, was saved; Diebitsch forced to pull back to the east bedeviled by limited supplies plus an increasing sick roll. He did much better at Ostrołęka, on 26 May, but never saw any medal as the Field Marshal died on 10 June from the cholera Russian armies had carried back from the East.[43]

A week after Stoczek, Dwernicki, now promoted to major general, smacked three regiments of Cossacks and chasseurs at Nowa Wieś. With another set of captured Russian cannon, a New York paper claimed Dwernicki was now nicknamed the „...Cannon Provider, because every moment he is bringing in some fresh piece he has taken from the enemy."[44] His last campaign was an April offensive into the Ukraine designed to raise partisans. Dwernicki took 7000 men and 12 guns running into General Theodor von Rüdiger's 11,000 Russians with 36 guns on the River Styr.[45] Circumstances favored Dwernicki, as he had not crossed, and there was but one bridge. Using musket and cannon fire, he tossed back von Rüdiger's

42 Schiemann, *Erinnerungen von Alexander*..., Vol. III, p. 94.

43 For details see Tadeusz Stachowski, „Between Waterloo and the Alma. The Polish-Russian War of 1831, Part I: Grochow," *in History Today* Vol. 29 (May 1979) No. 5: 310-317; and „...Part II: Ostrolenka," in *History Today*, Vol. 29 (June 1979) No. 6: 386-393.

44 „Poland," in *Spirit of the Times* [Batavia, N.Y.] (n.d., n.p.). Accessed online 24 March 2013.

45 In Russian, Fyodor V. Ridiger, a Livonian German who joined the Tsar's forces in 1800.

determined assaults. This started the battle of Boremlen (18–19 April 1831), where Dwernicki had to repel several more attacks. Although both sides suffered similar casualties and were prepared for additional combat, this was not a viable option for the Poles. As a much larger Russian force moved to engage, Dwernciki took his troopers across the Austrian frontier where they were interned until the fall of 1831.[46] By then, Warsaw was about to capitulate and the November Insurrection ended in early October.[47]

For men like Dwernicki, capitulation was not an option. He made for Paris and was soon engaged in émigré politics. Jean Gigoux's 1833 portrait of the general makes clear he also maintained that love affair with food and spirits. Lionized as a revolutionary hero, he was the subject of *Polenlieder* (Songs for the Poles) like the *Dwernicki March*, which played as far west as Boston.[48] Polish writers found him equally attractive, Gustav Ehrenberg used Stoczek as the battle reference for *Gdy naród do boju* (When a Nation Goes to War), while Wincenty Pol's *Krakusy*, in honor of the volunteer cavalrymen, starts with the well-known stanza...

Grzmią pod Stoczkiem armaty,
Błyszczą białe rabaty
A Dwernicki na przedzie
Na Moskala sam jedzie.

(The cannons roar at Stoczek,
The white lapels bright
And at the fore Dwernicki
rides alone against the Muscovite.)

Dwernicki retired to Austrian Poland in 1848, dying nine years later. How did his actions impact on military affairs and Polish history? What can one learn from Józef Dwernicki

46 Punctual, as only Hapsburgs could be, the Austrians returned all captured Russian gear to General von Rüdiger, but retained all weapons with Polish markings. „Brody, May 10," in *Free Press* (27 July 1831). Accessed online 24 March 2013.

47 Stefan Przewalski, „Bitwa pod Boremlem, Studia i materiały do historii wojskowości," in *WMON*, Vol. IX (1963) No. 2: 231-255.

48 „Dwernicki," in Ernst Ortlepp (ed.), *PolenLieder* (Altenberg, 1831), p. 38; Charles Zeuner, *Two Grand Polish Marches* (Boston: C. Bradlee, 1831). For more on German support for the Poles, see, Anneliese Gerecke, *Das Deutsche Echo auf die Polnische Erhebung von 1830,* (Wiesbaden: Otto Harrassowitz, 1964).

and the battle of Stoczek? Although small, it provides several clear lessons. The need for good reconnaissance, that commanders must comprehend limitations terrain places on their movement, and how victory demands rapid and correct decisions. Dwernicki understood these well, and demonstrated top-notch leadership.

Modern Poles remember him as the dashing cavalier who won nearly every battle and set an example for future generations to fight no matter the odds, until Poland was free. It was a long wait, complete with more failed uprisings, but victory finally arrived in 1918. Modern Poland commemorated Dwernicki with numerous statues, street names, but possibly more dear to the general's heart, named the Second Ulan Regiment in his honor (*2 Pułk Ułanów Grochowskich im. Generała Józefa Dwernickiego*), a tradition maintained by the Fourth Armored Cavalry Brigade into the 21st Century.

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THE LUFTWAFFE'S CAMPAIGNS IN POLAND AND THE WEST 1939–1940: A CASE STUDY OF HANDLING INNOVATION IN WARTIME

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Abstract

Although the Luftwaffe won a signal victory in the Polish campaign in September 1939, the campaign also exposed many serious flaws in the doctrine, tactics, equipment and organization of the Luftwaffe. The Luftwaffe used the experience of the Polish campaign in a very effective program to examine and revise the Luftwaffe`s doctrine and tactics in time for the gr4eat campaign in the West in May/June 1940. Germany's success against the Western powers in 1940 was, in large part, due to the superior doctrine and tactics of the Luftwaffe. This article is a case study of how a military force can effectively learn from recent operations and quickly apply the lessons in the form of doctrinal change.

Key words*:* World War II, Polish campaign 1939, Campaign in the West 1940, airpower, Luftwaffe, military doctrine

Introduction

During and after the campaign in Poland in September 1939 the Luftwaffe staff and leaders conducted an analysis of the performance of tactics, organization and equipment with the intent of modifying doctrine and equipment for the conduct of future operations. In many respects the Luftwaffe leadership proved to be very adept at learning lessons from campaigns and quickly putting those lessons to work. The lessons learned in Poland, when the Luftwaffe was at the

peak of its operational effectiveness vis a vis its opponents, played a major role in determining the course of Luftwaffe doctrine for the rest of the war. Studying the Luftwaffe in this period also provides some insights into how well an air force can adapt itself to the rapidly changing conditions of warfare.

The Luftwaffe entered World War II with a large combat force of 4,333 aircraft[1]. Ever since World War I, the secret air staff of the Reichswehr and, after 1935, the Luftwaffe had been hard at work developing doctrine and equipment and testing its doctrine in maneuvers and in actual war. The Luftwaffe's basic doctrine, Luftwaffe Regulation 16 (*Luftkriegführung*) stressed strategic air war as well as deep interdiction campaigns to support a ground campaign. The air superiority battle was given considerable role in Luftwaffe doctrine and, from World War I on, the Luftwaffe put considerable emphasis upon air defense with flak forces. While close air support of the ground troops had been part of German operations and doctrine since World War I, the extensive and decisive use of the German Condor legion in close support operations in the Spanish Civil War had recently placed a greater emphasis on this aspect of aerial warfare in Luftwaffe doctrine.

The Luftwaffe saw developing doctrine as part of an ongoing and dynamic process. Throughout the 1930s, new equipment, organizations and tactics were tested in large-scale maneuvers. Some of the maneuvers included army divisions and hundreds of aircraft. The operational staffs critically analyzed each of the major maneuvers and wargames and air staff in order to glean lessons. The war in Spain from 1936–1939 served as an extended "live fire" exercise in which the Luftwaffe not only tried out its latest aircraft models, such as the Me 109 fighter and Ju 87 dive bomber, but also conducted most types of air operations to include strategic bombing, interdiction, naval air strikes and close air support. The successive Condor Legion commanders and staff sent regular reports to the air staff in Berlin which used these lessons as a basis for rewriting operational doctrine and also modifying the force organization, aircraft and equipment. One example of the successful use of war experience in modifying doctrine is the new fighter tactics developed in Spain by Luftwaffe ace Werner Mölders. Mölders developed

1 On 1 Sept. 1939 the Luftwaffe had 1,180 bombers, 771 fighters, 408 Me 110 destroyers, 40 Hs 123 Attack planes, 721 reconnaissance planes, 240 naval aircraft and 552 transports. See Hans Detlef Herhudt von Rohden. *Die Deutsche Luftruesting 1935–194*5. Luftkrieg Heft 6. MS Air University Library circa 1950.

a very flexible and effective fighter tactics using pairs of aircraft and groups of pairs (finger-four formation) and proved the superiority of these tactics in battle. The air staff brought Mölders back from Spain and put him to work on writing a fighter tactics manual for the Luftwaffe.[2] Superior tactics gave the Luftwaffe fighters a great advantage over their British and French opponents who went into battle in 1940 with awkward and ineffective squadron "V-formations" and "line astern" squadron formations. In 1939, the air staff formed a special section devoted specifically to analyzing air operations and developing and adapting doctrine in light of experience. The doctrinal changes were published in a series of bulletins circulated throughout the Luftwaffe. In short, when World War II began, the Luftwaffe possessed a fairly sound methodology for developing and modifying doctrine, equipment and organization. As a consequence, the Luftwaffe entered the war with a well-balanced doctrine and organization capable of conducting a wide variety of operations.

Preparation for the Polish Campaign

In many respects, the Germans were well prepared for a war against Poland. Throughout the 1920s Poland was at the top of the Reichswehr's list of likely war enemies and a standard scenario of the 1920s exercises and wargames was an attack upon Germany by a Polish-French alliance. Even in the 1920s German military thinking favored the employment of large mobile formations against the Poles, and encircling and destroying Polish armies in large envelopment operations. The secret Luftwaffe staff put considerable thought into an air campaign designed to cripple the Polish forces. The "operational air war" concepts developed in the 1920s were especially suitable for fighting Poland. An important German advantage in planning for a war against Poland was good intelligence. Since Poland had long been the focus of German war planning the military and civilian intelligence

2 Ernst Obermaier and Werner Held, *Jagdflieger Oberst Werner Moelders* (Stuttgart: Motorbuch Verlag, 1986) p. 14.

agencies had collected a large amount of information about the Polish forces, Polish war industries and Polish defenses.[3]

The Germans had a good understanding of the Polish forces and their strengths and weaknesses and the Luftwaffe was poised to exploit the Polish weaknesses. In the air war doctrine of 1920s and 1930s, the first priority of the air force, would be to gain air superiority by attacking and destroying the enemy air force on the ground. Once the Luftwaffe had air superiority the next target priority for the air forces would be the military infrastructure and national rail net.[4] Poland, a nation with few good roads and few vehicles, was almost completely dependent upon its railroads for moving and supplying its army. If the rail network were crippled, the Polish army would be unable to effectively respond to a rapid German advance.[5] The Polish forces that attempted to maneuver against the Germans would be interdicted by the Luftwaffe and hopefully wrecked as a cohesive force long before they reached the front lines. A lower priority for the Luftwaffe was providing direct close support for German forces engaged in the ground battle.

The Germans needed to exploit every advantage against Poland because a quick victory was a strategic necessity. Although Hitler did not expect Britain and France to fight over Polish rights, if the Western allies did honor their commitments and went to war the western border of Germany would be highly vulnerable to attack as the Wehrmacht's best forces were all committed to the war in the east. In 1939 German rearmament was in high gear and there were ample first line army and Luftwaffe forces to provide a decisive superiority over the Poles – but Germany's forces were not enough to fight a two front war against the Western Allies as well. The campaign in Poland required the commitment of all of Germany's elite panzer

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3 Some German intelligence documents from the 1920s on Poland still exist. In January 1927 the Luftwaffe Section of the Reichswehr's Intelligence office produced a detailed analysis of the Polish Air Force, its organization, equipment and major bases. See NARA T-177, Roll 9 Memo: T.A. (Luft) *Polnische Luftstreitkräfte*. Berlin 25 January 1927.

4 On the major doctrine documents of the "Operational air war" see James Corum and Richard Muller, *The Luftwaffe's Way of War* (Baltimore: Nautical and Aviation Press, 1998). See the 1926 Operational Air Doctrine, pp. 86-112, and Luftwaffe Regulation 16, which was the main operational doctrine for the Luftwaffe, pp. 118-157.

5 In 1934 the Luftwaffe staff carried out a study on how to paralyze the Polish forces in case of war and concluded that the Polish rail system was especially vulnerable to German Stukas and bombers and would be the center of gravity for a German attack. See NARA T-78 Roll 128 Reichswehr Ministerium, "Die Zukünftige Kriegführung in der Luft und ihre Auswirkung auf die Bewegungen des Heeres".

and motorized divisions as well as its best trained and equipped infantry units. Most of the Luftwaffe would have to be deployed if the Polish Air Force were to be destroyed quickly and the Polish transportation net crippled. As long as the Wehrmacht was committed to Poland only a few dozen infantry divisions, mostly reserve units in a low state of training, would be available to defend Germany's western border. If the French and British attacked while the main force of the Wehrmacht fought in Poland they would have superiority in troop numbers and armored forces, and artillery. In the air the meager Luftwaffe forces defending the Western Front would also face far superior Allied forces.[6]

Hitler gambled that if the Britain and France came to Poland's aid they would not move quickly against Germany. Still, for the weeks that the main German forces were in the east Germany would be highly vulnerable. Therefore, the Polish campaign was planned with speed as the top priority. Poland would have to be defeated quickly so the Wehrmacht could redeploy its forces to the west. However, the Germans had good reasons to believe that they could gain a rapid victory in Poland. The Germans outnumbered the Poles in the air by a factor of seven to one and the Germans had a huge advantage in terms of the quality and amount of their equipment on the ground and in the air. While the Poles had a large army it possessed few tanks or even motor vehicles. Its artillery was far inferior to the Wehrmacht's and it was desperately short of essential equipment such as radios. Because the German military had long planned for a war with Poland it had a highly developed logistics infrastructure in place near the Polish border to support its forces. The Luftwaffe was especially well-prepared for operations in the east. On Poland's southern flank the Luftwaffe's 4th Air Fleet had 74 airfields and 19 airfield companies to support its operations. On the northern flank the 1st Air Fleet had 29 airfields and 20 airfield companies in Pomerania and additional airfields and units available in East Prussia.[7]

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6 During the Polish campaign the Luftwaffe forces on the Western Front consisted of the 2nd Air Fleet with 557 planes and the 3rd Air Fleet with 579 planes for a total of 1136 combat aircraft—a force far inferior to what the Western Allies could deploy. **See E. R. Hooten,** *Phoenix Triumphant: The Rise and Rise of the Luftwaffe* (London, 1994) p. **189.**

7 Hans Detlef von Rohden, *Luftkrieg Heft 5: Die Planung und Vorbereitiung des Luftkrieges gegen Polen,* MS Air University Library, 1946. **Anlage 6.**

The army and Luftwaffe plans for the campaign against Poland were developed and finalized in a major wargame in May 1939 and the Luftwaffe staff issued detailed guidance to the 1st and 4th Air Fleets that were tasked to support the campaign.[8] German plans followed thinking that had evolved since the 1920s: the Luftwaffe would first cripple the Polish air force on the ground and then bomber and Stuka units would hinder the Polish mobilization and troop movement by bombing the rail network. The Luftwaffe would support a rapid advance by the army by air interdiction of Polish troop formations moving to the front. The army and Luftwaffe planned to crush Poland through two great simultaneous offensive thrusts from the north and south. Five armies of the northern and southern army groups would advance on Warsaw using the armored and motorized divisions in task forces to drive ahead and encircle the Polish armies deployed along Poland's western and southern borders. The 1st Air Fleet, with 1,105 combat aircraft under the command of General Albert Kesselring, was based in northeast Germany and East Prussia and was tasked to support the operations of the Northern Army Group (the 3rd and 4th Armies under the command of Colonel General Fedor von Bock). The 4th Air Fleet was under General Alexander Lohr, the former chief of the Austrian Air Force who joined the Luftwaffe on the Anschluss of Austria with Germany in March 1938. Based in southeast Germany and Slovakia the 4th Air Fleet would support the Southern Army Group (8th, 10th and 14th Armies under the command of General Gerd von Rundstedt). The 4th Air Fleet deployed 729 combat aircraft in the campaign. In addition to the combat aircraft of the two air fleets the two army groups had 262 Luftwaffe reconnaissance aircraft, mostly light Henschel 126 planes that operated under army command and were to serve as the tactical eyes of the army. Another 100 fighters were posted along the Polish border for home air defense and another 56 aircraft assigned to naval reconnaissance in the Baltic. This gave the Germans a German total of 2,152 aircraft for the eastern campaign.[9]

The main German thrust would be made by von Rundstedt's Southern Army Group which was allocated four of the army's six panzer divisions. Rundstedt decided that the main effort to break the Polish army would be made by Colonel General von Reichenau's 10th Army and his army was allocated two panzer divisions, two light divisions (motorized divisions with some tanks) and two motorized divisions. This

8 Oberbefehlshaber der Luftwaffe, *Planstudie 1939*, 1 May 1939 NARA T 321 Roll 172.
9 Hooton, *Phoenix Triumphant*, p. 177.

was an awesome concentration of mechanized might for 1939.[10] The 10th Army's mission was to drive northeast to Warsaw from Silesia. Its left flank would be covered by the 8th Army and on the right flank the 14th Army, with two motorized divisions, would drive into central Poland from Slovakia. The Poles positioned their armies along the frontier, with the bulk of the forces in Western Poland, so a German drive on Warsaw would have to overrun some of the Polish forces while leaving most of the Polish forces deployed on Poland's western border to be encircled and annihilated. Once the path to Warsaw was cleared the capitol was expected to fall quickly. With Warsaw gone Polish resistance was expected to collapse. At the time of the spring and summer wargames Hitler did not tell his military leaders of his secret negotiations with Stalin that would ensure Poland's rapid destruction by inviting the Soviet Union to ally with Germany and invade Poland from the east. The German-Soviet Pact announced in August 1939 was a master stroke that ensured the swift defeat of Poland. With the Russians to join the war the Poles had no option to retreat to the east.

The Luftwaffe of 1939 and 1940 possessed significant advantages. First of all, it was a much better trained force than any of its opponents. The Polish and Western Allied air forces had good pilot training programs that produced individual pilots equal to the Germans, but the Luftwaffe had also emphasized training its large units and staffs to ensure that they were mentally and doctrinally prepared for a modern rapid-moving war of maneuver. From 1935 on the Luftwaffe carried out an extensive program of large-scale maneuvers and had stressed training in cooperation with the army. Following the German general staff tradition the Luftwaffe staffs conducted a regular program of wargames and communications exercises to familiarize the air corps and air fleet staffs with the complexities of major combat operations.[11] Air warfare doctrine and plans were tested in wargames as a means to expose flaws and identify requirements for new tactics, munitions and equipment. The Luftwaffe's most dangerous opponents, namely the Western Allies and the USSR, generally failed to conduct these types of large scale unit and staff training exercises and failed put their own tactics and doctrine to the test.

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10 Robert Citino, *The German Way of War* (Lawrence: University Press of Kansas, 2005) pp. 257-262.

11 See James S. Corum, "Preparing the Thunderbolt: Luftwaffe Training Exercises Before World War II." in 1998 National Aerospace Conference; The Meaning of Flight in the Twentieth Century, ed. John Fleischaer (Dayton OH: Wright State University, 1999) 294-302.

The only example of a comprehensive testing of doctrine and development of concepts in Europe through large scale exercises was the air defense system of the UK. It is also no coincidence that this was the one notable victory for the Allied powers in from 1939 to 1942. Given the fairly slight numerical and technological advantages that the Luftwaffe had in 1939 against the combination of the combined allied air forces the remarkable success of the Luftwaffe in 1939 and 1940 can be largely attributed to the superior training program, the Luftwaffe's experience of large scale aerial combat in Spain, and the ability of the Luftwaffe to quickly and critically analyze the lessons of recent combat and to make rapid changes in doctrine, equipment and force structure to correct flaws.[12]

German Operational Air Doctrine on the Eve of War

On 1 August 1939 the Luftwaffe's new chief of staff Hans Jeschonnek sent senior commanders guidelines for the use of the Luftwaffe in support of ground forces.[13] The guidelines were based on the Luftwaffe's experience in Spain and on the current German operational thinking. The first principle laid out was that the air commanders would decide where and how to employ air forces against ground targets.[14] Senior commanders were encouraged to think of the larger picture, i.e. the objectives of the whole campaign, and not just about their immediate mission. The guidelines reminded commanders that attacks against enemy transportation targets, depots and rear areas might have an even greater operational effect than attacks on frontline enemy forces.[15] The directives viewed air support for the army mainly in terms of interdiction operations designed to cut off the forward elements of the enemy forces by destroying the roads and rail nets in the rear and attacking enemy columns on the roads. Such interdiction operations denied the

12 James S. Corum, "The Luftwaffe and Lessons Learned in the Spanish Civil War." in *Air Power History: Turning Points from Kitty Hawk to Kosovo*, Eds. Sebastian Cox and Peter Gray (London: Frank Cass, 2003) 66-92.

13 Oberbefehlshaber der Luftwaffe (signed Jeschonnek), *Richtlinien für den Einsatz der Fliegertruppe zur unmittelbaren Unterstützung des Heeres* 1 August 1939. In NARA File T 321 Rolle 76.

14 Ibid para. 1.

15 Ibid para 15-16.

enemy's ability to maneuver or retreat. In any case, it was far simpler and more efficient to destroy an enemy column on the road than one that was dispersed and deployed for battle. Attacking the enemy army well behind the front lines also reduced the possibility of "friendly fire" casualties.

In line with traditional German thinking about employing mass against the enemy "Schwerpunckt", the guidelines recommended that the Stuka groups not be broken into small groups for individual missions but used in mass, usually group strength (30–40 aircraft), in order to achieve an operational effect and to be sure of destroying the target.[16] The directives of the Luftwaffe chief of staff noted that aircraft were best employed outside the range of the army's artillery except on special occasions when aircraft delivered bombs might be required to ensure destruction of an important target.[17] This advice was particularly important because in 1939 the Luftwaffe, although it had a sophisticated communications network for the time, still did not have the capability to control or guide air attacks from the ground. The army practiced various ground signaling measures such as laying out panels, marking their lines with colored smoke and displaying swastika flags on the top of German tanks and armored cars as means to ensure that Luftwaffe aircraft did not bomb German troops by mistake. German ground troops were to be warned when the Luftwaffe was about to make attacks in their vicinity.[18] Yet the closer the Luftwaffe flew to German ground troops the greater the chances for accidentally bombing one's own troops. At 12,000 to 15,000 feet, the usual height for Stukas to begin their diving attacks, German guns, troops and vehicles on the ground looked no different from Polish troops. To deal with this fact the Luftwaffe and army commanders would determine a "bomb line" along the army front and forbid the Luftwaffe to bomb short of the line unless the circumstances were exceptional or in the case of a carefully planned attack upon a clearly identifiable enemy target.

Major Luftwaffe combat formations, the air corps and some air divisions, had a "Close Battle Commander" (Nahkampffuehrer) who had the responsibility of tasking aircraft to conduct close air support of ground operations. Doctrine specified that close air support would not be used in "penny packets' distributed

16 Ibid para 12.
17 Ibid para 14.
18 Ibid para 22.

throughout the army (although many of the army commanders favored such an approach), but was to be used in accordance with the high command's priorities with support concentrated and devoted to the army units at the *Schwerpunkt* of the campaign. The Luftwaffe and air fleet daily orders designated the Schwerpunkt for each day's operations.[19]

As a result of the Spanish experience, the Luftwaffe began to place considerable emphasis upon close support of ground troops and in the Summer of 1939 the Luftwaffe created a new kind of air unit, the "Special Purpose Force", a provisional air division composed of four Stuka groups (160 aircraft), one Hs 123 group (40 aircraft) a reconnaissance squadron and two fighter groups for escort.[20] This force was placed under the command of Major General Wolfram von Richthofen who had proven the capabilities of CAS (close air support)as chief of staff and commander of the Condor Legion.[21] This force would be used in mass and deployed to support the German forces at the "Schwerpunkt" of the campaign.

Richthofen put together a first rate staff, heavy on veterans with experience in Spain. His air division chief of staff was Lieutenant Colonel Seidemann, who had served in Spain with Richthofen. It was a very effective partnership and Richthofen worked well with Seidemann. Thanks to their Spanish experience these two airmen knew much better than other German commanders just what kind of problems they could expect in Poland. Richthofen's chief of logistics was Major Paul Deichmann, another Spanish veteran. Both Seidemann and Deichmann would serve with Richthofen in other campaigns and in the course of the war both would be promoted to general rank and given major commands of their own. Von Richthofen had Major Siebert attached to the staff to manage communications. Siebert served as communications officer for the Condor Legion in 1936–1937 and Von Richthofen gave much of the credit for the operational successes in Spain to Sibert, who Richthofen thought was brilliant in his ability to establish effective communications nets. The Spanish experience shaped von Richthofen's approach

19 The Luftwaffe close air support doctrine was outlined in Oberbefehlshaber der Luftwaffe, *Richtlinien für den Einsatz der Fliegertruppe zur unmittelbaren Unterstützung des Heeres*, Air Staff: Berlin, 1 Aug 1939.

20 Hans von Rohden, ed. *Luftkrieg. Heft 5: Die Planung und Vorbereirung des Luftkriegs gegen Polen 1939*, MS: Air University Library, Nov. 1946, p. II.

21 Wilhelm Speidel, *Die Luftwaffe im Polenfeldzug 1939*, USAF HRA, Karlsruhe Collection, K 113.106-151, p. 18.

to the battle in Poland. In his guidance to his commanders, and in his meetings with superiors and army commanders, Von Richthofen insisted that his strike forces should only be used in mass, with at least an entire Stuka or attack group (30–40 airplanes) employed on a mission. Richthofen had learned in Spain that major operational effects could only be achieved by delivering major blows with many airplanes.

The Luftwaffe in the Polish Campaign September 1939

In most respects, the German air campaign against Poland went according to the plan. The Germans began with an air superiority campaign against the Polish airfields. The next priority was a series of deep interdiction attacks that paralyzed the Polish rail system and major bridges which greatly hindered Polish Army movements and mobilization.

The effectiveness of close support operations in Poland was especially dramatic. Large Polish formations in well-fortified positions, such as at Modlin, were subjected to heavy aerial bombardment with a consequent collapse of morale of the defenders.[22] In other cases, large Polish units on the road were discovered by the Luftwaffe's tactical reconnaissance forces and cut to pieces by the Luftwaffe in the Radom-Deblin area and on the Byzura River.

Some of the best critical sources for understanding the Luftwaffe's air campaign in Poland and on the Western Front are the diaries of Major General Wolfram von Richthofen. The commander of the Special Purpose Division maintained a detailed daily log book that included notes of all the problems the Luftwaffe encountered as well as a log of daily operations. Through von Richthofen we have a clear idea how the air campaign in Poland developed. The Special Purpose Division supported the 10th Army, which was the Schwerpunckt of the campaign and carried out interdiction, close support and long range bombing missions. Throughout the campaign Von Richthofen or his chief of staff coordinated daily

22 Hans von Rohden ed., *Die Planung und Vorbereitung des Luftkriegs gegen Polen 1939*, p. II.

operations with the 10th Army and most Stuka and Henschel strikes on any day were upon targets chosen by the Special Purpose Division after consultation with the army headquarters. Generally at least one Stuka or attack group with a squadron or two of Me 109s for escort would be kept fueled and armed and ready to take off immediately to strike any target identified by the army or by the Special Purpose Division's own reconnaissance planes. Within minutes of receiving an attack order the Stuka or Henschel group would be on its way and protected by its escorts. For 1939 this was a highly advanced system. However, as the 10th Army's tanks advanced rapidly through the Polish Krakow Army, the main problem for both the army and the Luftwaffe was maintaining a "bomb line", a clear demarcation between German and Polish units in order to prevent the Luftwaffe from bombing German troops. The advance of the German armor forces was so rapid that neither the 10th Army nor its corps or division headquarters were clear as to the location of the most advanced German forces. By the third day of the campaign von Richthofen's most common complaint was a lack of clear information as to the location of the 10th Army's units. The Luftwaffe officers attached to the army, and possessing their own reconnaissance aircraft, were no more helpful than the army in providing clear information on German or Polish troop dispositions. Von Richthofen deployed his own reconnaissance aircraft and his Flivos assigned to the 10th Army and the corps headquarters to get information. Finally, he took to flying around the battlefield himself in his Fiesler Stork and he carried out personal coordination with General von Reichenau and the 10th Army headquarters on an almost daily basis.

One of the reasons von Richthofen needed to coordinate operations face to face is that he believed that the senior army commanders did not understand the capabilities of airpower and that unless he took the initiative to propose missions and advise the army commanders how his air units might support their operational objectives, then the Luftwaffe would either not be used, or would be deployed in small units across the front, trying to answer every request and failing to have a decisive effect. At various times during the Polish campaign, when higher headquarters did not offer specific directives or provide clear requests for Luftwaffe support, von Richthofen would take the initiative to provide operational directives for his air units to attack the Polish transportation net behind the front—attacks which had much greater operational effect on the battlefield than close air support. When clear guidance from the air fleet headquarters was lacking,

von Richthofen would send out his own reconnaissance units to find Polish troop concentrations in the rear. On 16 September von Richthofen, on his own initiative, sent his air units to attack Polish troop concentrations and rail transport east of Lublin, and thus hindered the Polish counterattacks.[23]

The campaign in Poland exposed a number of serious flaws in the German doctrine, organization and equipment. The most serious problem in the campaign was the lack of effective command and control of the Luftwaffe units flying in close support of the army. This was von Richthofen's constant refrain in his diary. At the start of the war, the Luftwaffe had two different and unconnected command organizations for supporting the army. The first was a Luftwaffe officer assigned to each army to command the short-range air reconnaissance units detailed to provide the army with tactical intelligence. The Koluft (Kommandeure der Luftwaffe – commander of the Luftwaffe) was under the army command. He could communicate with the major Luftwaffe field headquarters but had no authority to order attack missions in support of the army. His control was limited to the light reconnaissance units under his command. The second means of army/Luftwaffe coordination were teams of air liaison officers (Flivos – Flieger Verbindungsoffiziere). The Flivos were usually fairly junior officers with a communications team who were attached to army corps headquarters and at the divisional headquarters of the panzer and motorized divisions. The Flivo's were tasked to keep the Luftwaffe air corps and air fleets informed of the situation on the ground. The Flivos remained under Luftwaffe command and had no authority to call in strike missions or command aircraft. The lack of common radio frequencies between the army and the Luftwaffe also posed a serious barrier to quickly passing vital information between the Luftwaffe and army and resulted in von Richthofen's headquarters often being in the dark as to the location of German army units and the conditions at the front.[24]

At the start of the campaign von Richthofen remained close to his headquarters reading reports as they came in and issuing attack orders. But by 4 September he was complaining about the lack of information he was getting from the front. Although the army was supposed to provide him with constant updates he noted that "army communications are worse than ours."[25] As in Spain, von Richthofen found it necessary to personally visit the front lines to see what was happening.

23 Von Richthofen Diary 16 September 1939.
24 E.R. Hooten, *Phoenix Triumphant,* pp. 183-184.
25 Von Richthofen Diary, 4 September 1939.

Leaving his chief of staff Seidemann to manage the battle operations von Richthofen would fly to Reichenau's army headquarters to personally coordinate operations. He also flew over the front to conduct his own reconnaissance. On 6 September he landed near the headquarters of the 1st Panzer Division, Reichenau's lead division on the drive towards Warsaw, to get an accurate view of the situation. Von Richthofen found out that the lead units of the 1st Panzer had run into some heavy Polish resistance and that the division's own artillery was stuck in a column to the rear and would take three to four hours to move up to provide effective fire support. Von Richthofen used the army's communications net, which for once seemed to work, and called Colonel Seidemann back and had him order the HS 123 group to immediately fly up to attack the Polish units in front of the 1st Panzer Division. The Henschels soon arrived and broke up the Polish counterattacks and allowed the 1st Panzer Division to continue its advance.[26] However, after bailing out the army, in his diary von Richthofen noted that the army had left its artillery far to the rear and that CAS should not be a substitute for artillery.[27]

Logistics were another serious problem for the Luftwaffe in Poland. As the 10th Army drove rapidly forward the short-range Stuka and fighter units of the Special Air Division needed to deploy forward in order to provide effective support to the army and to maintain a high sortie rate. However, supply columns were slow to catch up with the panzer and motorized troops advance. A panzer unit could carry several days of food and enough ammunition for a couple of days of combat on its own vehicles, but needed a great deal of fuel to keep moving. Fuel supplies became the factor that limited German operations. The 4th Air Fleet allocated one Ju 52 transport group to support both General Reichenau and Richthofen and by 3 September the transports were already being used to fly fuel forward to keep up the momentum of the advance. The further the panzers advanced into Poland, the more urgent the need for air transport of fuel became. On 3 September the Luftwaffe transports brought 30 tons of fuel forward for the 10th Army's 1st Panzer Division and on 5 September this requirement jumped to 74 tons. At the same time, von Richthofen began to move his short ranged Stuka and fighter units forward to former Polish airfields and he needed all the air transport he could get to keep his planes supplied with fuel and bombs.

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26 Von Richthofen Diary, 6 September 1939.
27 Von Richthofen Diary 5 September 1939.

Ju 52 transports were important to the Luftwaffe in moving men and materiel forward to captured airfield – Luftwaffe photo

The first jumps forward initially went well and Luftwaffe airfield companies quickly repaired the formerly Polish airfields for occupation by Richthofen's units. But maintaining a high sortie rate that forward bases allowed also meant a rapid expenditure of fuel and munitions. By 8 September Richthofen complained to his air fleet commander, General Lohr, that his supplies of fuel and munitions were so low that he would have to reduce his sorties. Shortages were so acute that on 11 September Richthofen reduced the sortie rate for some of his Stuka and fighter groups to one sortie per day. The problem was eased on 13 September when the Luftwaffe allocated two additional Ju 52 squadrons to support the 4th Air Fleet. Von Richthofen's forward groups were immediately given transport priority and the Stukas returned to their usual high tempo of four or more sorties.[28]

Through the campaign von Richthofen noted a number of friendly fire attacks by the Luftwaffe on German army units.[29] This was a constant problem for the Luftwaffe and the army in Poland and was the result of an awkward liaison system and the lack of common radio frequencies between the Luftwaffe and the army. All these issues would be addressed by the Luftwaffe staff after the Polish campaign.

28 Hooten, p. 184.
29 Von Richthofen Diary 16 September 1939.

The Bombing of Warsaw

Warsaw had been targeted several times in the first week of the campaign and specific military targets including airfields and railyards were struck by the medium bombers. On 12 September, with the Luftwaffe's short ranged Stukas and attack aircraft now stationed close enough, the Luftwaffe high command ordered both air fleets to make major air attacks on Warsaw General Grauert's 1st Air Division of the 1st Air Fleet attacked the city from the north. However, von Richthofen's Special Purpose Division, was still heavily engaged in the ground battle, and could muster only 183 sorties for the raid. When they arrived over the city Von Richthofen's pilots found that many targets were obscured by smoke from Grauert's attack so they could not bomb accurately. Von Richthofen complained loudly that neither his nor Grauert's attack was coordinated and no bomber units attacked on schedule and the attack apparently had little effect upon the Warsaw's defenders.[30] Von Richthofen met Goering in Radom the next day while Goering was making a tour of the front. At this meeting Richthofen argued that a single air commander needed to be appointed for the air assault upon Warsaw so that further attacks could be properly planned and coordinated. Richthofen also pointed out that he would be the best choice to command the operation, a bit of arrogance on his part as he was outranked by many other Luftwaffe generals in Poland. On the other hand, with the Spanish experience behind him, he also had more experience than any other Luftwaffe general in Poland in coordinating large operations.[31]

Forcing a quick surrender of Warsaw was viewed by the German high command as a strategic necessity. Von Richthofen believed that massive air attacks upon the city would break Polish morale and force a quick surrender—so he planned for a massive aerial attack with all available forces for the 25th of September. Von Richthofen's attack on Warsaw had characteristics of an indiscriminate terror raid. Hundreds of sorties were flown and by the end of the day Von Richthofen's air units had dropped 632 tons of high explosive and incendiary bombs on Warsaw.[32] Since the Luftwaffe had already begun deploying some of its bomber formations

30 Hooton, p. 186.

31 Hooton, p. 186.

32 In the 25 September attack on Warsaw the Luftwaffe dropped 560 tons of high explosive and 72 tons of incendiary bombs. Only two Ju 52s were lost in the attack. See Hooten, *Phoenix Triumphant*, p. 188.

back to the Western Front Von Richthofen could only conduct a large attack by using his Ju 52 transports as bombers. The Ju 52s flew over the city as airmen shoveled thousands of incendiary bombs out the cargo doors – nothing that one could describe as attacking only military targets or "avoiding unnecessary civilian casualties." On the other hand, by the rules of war in 1939 Warsaw was a defended city under siege – and therefore a lawful target of war.[33]

Von Richthofen's terror attack lowered the little morale the Poles still possessed. Yet, ironically, the massive air raid, the largest that had been seen to that time, was not the cause of Warsaw's surrender. The Polish commander in chief, then interned in Romania, was already aware that the situation in Warsaw was hopeless and he issued the order for Warsaw to capitulate on September 26 while he also initiated negotiations to surrender the last major pockets of Polish forces. The Polish government, already in exile, was not terrorized into surrendering Warsaw, but simply saw that nothing could be gained by further resistance. By 29 September, the city of Warsaw and all the remaining organized Polish military forces had surrendered to the Germans.

Although Von Richthofen's bombing of Warsaw had a small effect on the outcome of the Polish campaign it gave rise to a part of the mythology of Blitzkrieg. The international press reported the numbers of casualties from the aerial attack on Warsaw as between 20,000 and 40,000 dead and that the one attack had destroyed more than 10% of the buildings in the city and such figures remained in the history books over sixty years later.[34] In reality, sober analysis has to place the casualties and damage at a far lower level. If Warsaw's casualty rates were equal to the most lethal bombing raids of World War II in Germany then the casualty rates would be between 6,000 and 7,000 dead.[35]

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33 Hooten, *Phoenix Triumphant*, p. 188. The French air attaché in Warsaw noted stated that the German attack had been in accordance with the laws of war and that civilian casualties had been located close to legitimate targets. On the French air attaché's comments see Mike Spick, *Luftwaffe Bomber Aces* (London: Greenhill Books, 2001) p. 40.

34 For the 20,000 figure see "Wir warden sie ausradieren," *Der Spiegel*, No. 3 vol. 13, 13 January 2003, p. 123. Hooten gives the figure of 40,000 Poles killed. See Hooten, *Phoenix Triumphant*, 188.

35 The most deadly bomb raids of World War II were Hamburg in August 1943 and on Dresden of February 1945. In those two raids the fatality level was 7.2-10.2 fatalities for each ton of bombs dropped. The popular figures given for Warsaw casualties in 1939 would have made that attack four to six times more deadly than the Hamburg or Dresden raids-- an utter improbability as both Hamburg and Dresden saw huge firestorms. See James S. Corum, *Inflated by Air: Common Perceptions of Civilian Casualties by Bombing*, Air War College thesis (Air University: Maxwell AFB, AL, April 1998) 14-15.

End of Polish campaign – Von Richthofen Greets Hitler. General von Reichenau, in center with monocle. Hitler took a great liking to von Richthofen, who he considered one of his best generals – USAF photo

Another irony is that the sensational tone of the press coverage in the Western nations did nothing to help the Polish cause, but instead served the Nazi cause wonderfully. The international press presented the basically false image of the Luftwaffe as a force that could level whole cities and kill tens of thousands instantaneously— a capability way beyond the Luftwaffe's powers in 1939–1940. The Western media coverage presented a picture of Germany's ability to crush any nation that might resist Germany— all of which fit in nicely with the Nazi propaganda themes. Shortly after the end of the campaign Josef Goebbel's Propaganda Ministry amplified the Western media's description of the campaign in the film "*Feuerteufe*" (*Baptism of Fire*) that was shown in Germany and abroad. This dramatic film portrayed the German army in Poland as a mechanized force consisting of thousands of the most modern tanks and motor vehicles and gave a large role to the Stuka attacks. In fact, only a small part of the German army (less than a quarter of the army in 1939) consisted of modern motorized and mechanized divisions. The Stukas were impressive weapons, but were also highly vulnerable to anti-aircraft fire. Most of the German army of 1939 (and through the end of the war) consisted of infantry divisions that used horses as the main motive power to pull supply wagons and artillery pieces. But the German Propaganda Ministry very cleverly provided the world with a false vision of ultramodern and, hence,

unstoppable German forces. The Western media coverage of Poland, coupled with the official German propaganda, magnified the Luftwaffe's effectiveness and served the Nazi cause by demoralizing the civilians and military forces of the Western European nations that would soon be Germany's targets. The images of the bombing of Warsaw and the films of German tanks rolling through Poland shown in the West had much to do with the rapid collapse of Holland and Belgium and France in May and June 1940.

Lessons from the Polish Campaign

Warsaw was still burning when the Luftwaffe and the army began to analyze their operational performance in order to learn lessons as quickly as possible and to adapt their doctrine, force structure, equipment, and tactics to correct deficiencies exposed in Poland. For the Luftwaffe, it had not been an especially hard campaign. In one month of combat the Luftwaffe lost 285 planes from all causes (among them 67 fighters, 78 bombers and 31 Stukas) while a further 279 planes suffered more than 10% damage. This was a loss rate of under 10% of the aircraft used in the campaign.[36] These losses were quickly made good as new aircraft flowed from the factories and replacement personnel was sent from the training schools and the expansion of the Luftwaffe continued. Starting in October 1939 the Luftwaffe began publishing a series of tactical bulletins that were distributed to major Luftwaffe commands that highlighted problems seen in Poland and provided updates of tactical and operational doctrine.[37] The army established a similar office and moved to correct its flaws in equipment, organization and tactics.

The first lesson learned in the Polish campaign by the Wehrmacht's senior leaders was the importance of full cooperation of the army and Luftwaffe units. When the Luftwaffe and the army commanders were co-located and worked together

36 Adolph Galland, Karl Ries, *Die Deutsche Luftwaffe 1939–1945* (Dornheim, Podzun Verlag, 2000) p. 19.

37 Examples of the tactical directives outlining lessons from the Polish campaign sent by Luftwaffe headquarters to the air fleets are found in: Luftwaffe General Staff, Operations Branch, Richtlinien (Directives) to Luftflotte 2 (October 1939-January 1939). See NARA T-321 Roll 172.

decisive results were achieved. In the Luftwaffe's first assessment of the lessons learned from Poland in October 1939 the Luftwaffe general staff requested improved army/Luftwaffe communications links to enhance the cooperation of both services.[38] This lesson very likely came directly from von Richthofen. Even though the Luftwaffe had an extensive communications system prior to the campaign it had still proved insufficient under actual war conditions.[39] Richthofen had been vociferously critical about his communications problems. In the case of pre-planned attacks the communications system was sufficient. But under the pressure of rapid mobile operations the liaison system often broke down.

The Luftwaffe staff was not happy with the Koluft system. Koluft officers and reconnaissance units that served the army could have been very useful to the Luftwaffe in identifying targets, but the Koluft was not in the same communications system as the Luftwaffe air divisions and corps. Therefore, the Koluft played little role in supporting the Luftwaffe. In combat it often took hours for the Koluft's reports to work through the army communications system to reach the air fleet headquarters. The Flivos only operated at the higher army headquarters and during the rapid ground advances of the Wehrmacht were often unable to provide a current and accurate depiction of the ground situation. Thus, the Luftwaffe was often unsure of the location of the army units and this was the cause of the incidents of Luftwaffe Stukas and bombers attacking German columns.[40] To improve liaison senior Luftwaffe commanders started following Von Richthofen's example and developed closer personal liaison with the senior army commands.

In the light of the Polish campaign neither the army nor the Luftwaffe was happy with the liaison system. The army wanted better communications and more authority to the Koluft to direct operations. The Luftwaffe did not like the Koluft system as it divided liaison, information exchange and coordination into two channels. On the other hand, the Luftwaffe rated the Flivos' performance in

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38 "Taktik Luftwaffe: Taktische Erfahrungen Nr. 2. **Ausfertigung für Führungsstellen,"** Circa October 1939. in BA/MA RL 2 II/280. p. 15.

39 For a good analysis of the Luftwaffe's communications system in the Polish campaign see Karl Klee, "Die Luftnachrichtentruppe im Feldzug gegen Polen." *Wehrwissenschaftliche Rundschau* No. 4, 1954. 71-123. The Luftwaffe deployed 70,000 signal troops for the campaign with five Luftwaffe signals regiments deployed as well as parts of two others.

40 Wilhelm Speidel, *Die Luftwaffe im Polenfeldzug 1939*, USAF HRA Karlsruhe Collection Doc 113.106-151. pp. **157-158.**

Poland as fairly effective and created more Flivo teams and gave the Flivos better communications and more mobility.[41] This reform would have a major impact on the 1940 campaign in the West. A top priority for the Luftwaffe after the Polish campaign was to improve the communications and reporting nets.[42] Eventually, in 1942, the Luftwaffe would dispense with the Koluft system and place all short-range reconnaissance aircraft under Luftwaffe operational command. In the short term, however, some improvements made Luftwaffe communications in time be used in the spring of 1940. In Poland Hs 126 light reconnaissance planes could only transmit information to the artillery in Morse code. For the spring 1940 campaign they had voice radios installed for more effective artillery spotting.

Another major problem noted by the Luftwaffe leaders was the difficulty of maintaining logistics in the middle of the campaign. This was the greatest limiting factor for an organization such as the Special Purpose Division that had mostly short range aircraft and needed to fly from forward airfields. Although the Luftwaffe had a considerable number of motorized supply columns and airfield companies for the Polish campaign, units such as the Special Purpose Division still ran low on fuel and munitions at forward airfields. The air transport assets allocated to the Luftwaffe tactical units had been insufficient. For future operations the Luftwaffe would need more transport units if it wanted to support a blitzkrieg-type campaign.

Yet the Luftwaffe failed to take the limitations of a logistics system designed only for short campaigns seriously. While the Luftwaffe's airfield units could keep forward units supplied with fuel and bombs, the Luftwaffe groups and wings had only a minimal capability to repair and rebuild aircraft. If an aircraft needed major repairs it had to be loaded onto a truck or rail car and shipped back to Germany where damaged planes were repaired or rebuilt at the factory. This lean repair and maintenance infrastructure saved the Luftwaffe money but it also meant that damaged aircraft were out of action for a long time. The system worked in the short campaigns of 1939 and 1940 when the Luftwaffe could throw every available aircraft into the battle, win quickly and rebuild the force after the battle.

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41 Ibid. p. 149.

42 Williamson Murray, "The Luftwaffe Experience, 1939–1941" pp. 71-114 in *Case Studies in the Development of Close Air Support* ed. Benjamin Franklin Cooling (Washington DC: Office of USAF History, 1990) 78-79.

However, if the air war became an attrition war, the lack of forward maintenance and repair units guaranteed that the unit aircraft serviceability rates would drop precipitously. Starting with the Russian campaign in 1941, this is precisely what happened.

After the Polish campaign the Luftwaffe support had greatly impressed senior army commanders and the army gave much of the credit for the success of the campaign to the effect of Luftwaffe interdiction attacks and attacks on Polish forces. The interdiction attacks had worked well to cripple the Polish army's mobility and in some cases large Polish units on the road were discovered by the Luftwaffe's tactical reconnaissance forces and cut to pieces by the Luftwaffe—features of the destruction of Polish forces in the Radom-Deblin area and on the Byzura River.[43] Even the Luftwaffe seemed surprised at the effectiveness of Stuka attacks on Polish ground forces. Colonel General von Reichenau declared that the attacks of the Luftwaffe's "Special Purpose Force" had "led to decision on the battlefield".[44]

The Luftwaffe noted other strengths of their doctrine and organization in Polish campaign and decided to reinforce these successes for the 1940 battles to come. One of the great successes in the Polish campaign had been the flak units of the Luftwaffe. Germany had a large flak force in 1939 (over 10,000 flak guns compared with about 1,000 in France) and a large part of this force was in motorized units attached to the army for air defense. The flak units, which belonged to the Luftwaffe but were under the army's operational control, were distributed throughout the army in battalions and regiments. The flak force worked very effectively in their primary mission of air defense and usually shot down or drove off the few attacks made by the Polish Air Force.[45] However, the most important lesson from the Polish campaign was the effectiveness of the flak units, particularly the heavy 88 mm gun batteries, in direct fire against ground targets. The 88 mm guns had been used extensively in Spain for that purpose, so the flak units were already trained and prepared for that mission. In numerous cases, the 88 mm guns proved to be a superb and accurate weapon for taking out Polish bunkers and fortifications.[46]

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43 Murray, "The Luftwaffe Experience, 1939–1941" p. 81.

44 Speidel, *Die Luftwaffe im Polenfeldzug*, pp. 9-11.

45 On German flak in Poland see Horst-Adalbert Koch, *Die Geschichte der Deutschen Flakartillerie 1933–1945*, (Bad Nauheim: Verlag Hans-Henning, 1955) pp. 35-36.

46 Ibid.

In the aftermath of the Polish campaign, the chief of the Flak troops reorganized the flak forces to provide more effective anti-aircraft and direct fire support to the army. Two flak corps were created as permanent organizations for field support of the army. Each flak corp was composed of 3-4 flak regiments and supporting troops. The flak corps would be assigned to the armies with the main weight of the attack and would be under operational control of the army. However, the modified flak doctrine specified that flak units were to be kept well concentrated to cover the primary troop movements at the points of decision and were also to serve as an operational reserve for the army. [47] For example, as von Kleist's army group was given the primary mission for the advance into France, one of the flak corps was assigned to Gruppe Kleist. Other army units with a lower priority would get along with the support from the light flak units that were integral to the army (Heeresflak).

The Luftwaffe staff carefully studied the results of its air attacks against Polish targets and set to work to adapt its munitions to reflect the experience of the campaign. The Luftwaffe's standard 250 KG and 500 KG bombs worked quite effectively against interdiction targets such as the Polish rail system. Against strong fortifications, the Luftwaffe discovered that it needed heavier bombs with delayed fuses and deep penetration capability. Against ground troops in the open, the Luftwaffe discovered that a larger number of smaller bombs were more lethal than a few large bombs. By the campaign in France, a 1000-KG bomb with a delayed fuse and rocket assist would be ready to use against French fortifications[48]. The requirement for a light, antipersonnel bomb resulted in the development of the SD-2 cluster bomb. This was a canister that contained ninety-six bomblets of three pounds each –the first modern cluster bomb. When dropped, the container would break open and scatter the bomblets, armed with contact fuses, over a broad area with a devastating effect upon ground troops and unarmored vehicles. This weapon was ready by the Russian campaign where it would prove to be tremendously lethal.[49]

47 Koch, p. 38.
48 Speidel, W. *The Campaign for Western Europe, Part 1*, USAF HRA Karlsruhe Collection. Doc K 113.107-152, Pt. 1, p. 144.
49 Green, *The Warplanes of the Third Reich*, p. 382.

Absorbing the Lessons of Poland – Contrasting the Luftwaffe and Western Allies

From October 1939 to April 1940 the Germans used the lull in operations to absorb the lessons learned in the Polish campaign. In the winter of 1939/1940 the Luftwaffe kept to a busy schedule of exercises and staff wargames. The lessons from the Polish campaign had to be absorbed quickly as the Luftwaffe would face a much more formidable enemy than the Poles. In the winter of 1939/40 the Luftwaffe paid particular attention to improving communications links through the Flivos and air force headquarters and also developing better communications nets with the army.[50] The army and the Luftwaffe procedures were examined and staffs found many things to improve. For example, one of the major problems in coordinating air support between the army and the Luftwaffe was that the two services used different maps with different scales. Because the Wehrmacht had a program of wargames and planned exercises that involved both the airmen and army staffs this problem was examined and the army and the Luftwaffe commanders decided upon a common map for the campaign in the West. To simplify reconnaissance and air support Wehrmacht maps were marked with a common numbered grid system to plot enemy locations more easily and mark sites for Luftwaffe attack in the midst of battle.[51] The army/Luftwaffe staff exercises discussed the delivery of fuel and munitions to army Panzer units by Luftwaffe transport and these exercises culminated in a live exercise in early April 1940 where the Luftwaffe practiced delivery of fuel and munitions by airdrop. The army and the Luftwaffe supply units learned the art of loading and unloading transport aircraft and packaging supplies and rigging parachutes.[52]

Von Richthofen's unit, now expanded and renamed the VIIIth Air Corps was active with staff wargames and unit exercises and von Richthofen made improving liaison and communications his top priority. On 7 November von Richthofen

50 Michael Forget, „Die Zusammenarbeit zwischen Luftwaffe und Heer bei den Französischen und deutschen Luftstreitkräften im Zweiten Weltkrieg", in *Luftkriegführung im Zweiten Weltkrieg*, ed. Horst Boog, Herford (1993) pp. 497-525, see esp. pp. 511-512.
51 Florian Rothbrust, *Guderian's XIXth Panzer Corps and the Battle for France* (Westport: Praeger, 1990) pp. 40-42.
52 Ibid. pp. 42-43.

received the armored cars he had requested for his Flivos and modified them with appropriate radios so that they could effectively operate with the front line Panzer units.[53] In the spring von Richthofen also experimented with controlling Stuka attacks from the ground using his Flivos in their armored cars. The exercises showed promise but this experiment had to wait for the Russian campaign to be realized.[54] In November 1939 the VIIIth Air Corps received 10 Fi 156 Fiesler "Storks" for use as liaison planes. The Fieslers, with their astounding ability to take off and land in short fields, were a perfect airplane for liaison work. The ten Storks also provided the headquarters and staff of the air corps with the means to quickly move personnel to forward headquarters as they relocated during the battle.[55] Through November and December 1939 von Richthofen and his staff held talks with Reichenau's army staff and with General Dessloch of the newly-formed 2nd Flak Corps which would be supporting the ground forces and forward the Luftwaffe units on the northern flank of the offensive into France.[56] From October through April the Luftwaffe and the army planned the May attack together.

The Luftwaffe used the pause in operations to conduct unit training at all levels. For squadrons and groups this meant at the gunnery ranges and flying mock dogfights. Bomber units practiced flying and navigating at night. Headquarters conducted staff wargames. Army and Luftwaffe maneuvers were conducted with an emphasis on conducting joint operations. The contrast between the Wehrmacht and the Allied armed forces during this period, which came to be known as the "Phony War" is striking. The Germans trained and prepared with a sense of urgency for the campaign they knew was coming. The Allies carried out their normal battalion and regimental training exercises but very few large unit maneuvers or staff exercises. The French maintained an almost peacetime approach to training, while the BEF in France, 10 divisions by the spring of 1940, generally ignored any large unit training. When General Bernard Montgomery, then 3rd Infantry Division commander with the BEF, conducted a series of division

53 BA/MA N 671/5. **Nachlass von Richthofen. Kriegstagebuch der VIII Fliegerkorps** 5.10.39- 9. **5. 40. Page 8.**

54 Williamson Murray, "The Luftwaffe Experience, 1939–1941", p. 89.

55 BA/MA N 671/5. Nachlass von Richthofen. **Kriegstagebuch der VIII Fliegerkorps** 5.10.39- 9. 5. 40. see 6.

56 BA/MA N 671/5. Nachlass von Richthofen. **Kriegstagebuch der VIII Fliegerkorps** 5.10.39- 9. 5. 40.see 9-10.

exercises it was seen as a rare and revolutionary event. Indeed, Montgomery made some scathing comments about the lack of division and corps training in the British army of 1940. He pointed out that "In the years preceding the outbreak of war no large-scale exercises had been held in England for some time."[57] When the BEF was formed and shipped to France in the fall of 1939 there "was a total lack of any common policy or tactical doctrine throughout the BEF, when differences arose those differences remained and there was no firm grip at the top."[58]

The French air force and the RAF contingent sent to France were no better than the Allied armies in their attitude towards training. While the Luftwaffe airmen and ground crews complained that they were being worn out by constant training, a French Air Force officer noted the "inactivity of the months before 10 May..." on the part of the Allied air units.[59] While the Germans worked on absorbing the lessons of the Polish campaign the Allied powers seemed indifferent to learning from this most recent experience of large scale warfare. The several thousand Polish officers who had seen the German blitzkrieg escape the final capitulation and made their way to France and Britain could provide detailed information about German tactics, doctrine and equipment. But senior Allied commanders took little notice of the experience of their defeated Polish allies and maintained a solid confidence that French and British doctrine, organization and weapons were more than a match for anything the Wehrmacht could throw at them.

The Battle for France and the Low Countries

The Luftwaffe faced an exceptionally tough battle in the campaign against France and the Low Countries in May 1940. The scope of the Luftwaffe's operations at the start of the campaign was enormous as the Luftwaffe had to simultaneously support major paratroop and air landing operations in Holland, provide close support for the army units advancing upon Northern France and Belgium and

57 Bernard Montgomery, *The Memoirs of Field Marshal Montgomery* (New York: Signet, 1958) 43.

58 Ibid. 43, 49.

59 Anthony Cain, *The Forgotten Air Force: French Air Doctrine in the 1930s* (Washington: Smithsonian Institution Press, 2002) 124.

Holland and carry out attacks against the British and French air forces. Unlike the Polish campaign, the Germans faced strong opposition in the air and had only a marginal superiority in the quantity and quality of aircraft available for the campaign. Hence, better doctrine and tactics would be the key for the Luftwaffe in gaining air superiority and effectively supporting the German army offensive.

There had been enough time between the Polish campaign and the Battle for France for the Luftwaffe to absorb the lessons learned in Poland and make significant changes to its organization and doctrine. The Luftwaffe's innovations proved effective in the Spring 1940 campaign. The Luftwaffe's ground organization had been strengthened and proved very efficient in putting captured Belgian, Dutch and French airfields into operation as fighter and Stuka bases. With the British and French air forces still fairly intact after the first wave of German attacks upon forward Allied air bases, the Luftwaffe could only carry out its support missions and gain air superiority by means of a higher sortie rate than the Allies. The efficient operations of the Luftwaffe's mobile supply and airfield units enabled the Luftwaffe's fighter and Stuka units to maintain an average of four sorties per day throughout most of the campaign. The Luftwaffe's bomber aircraft maintained an average of one sortie per day. This is in stark contrast to the French Air Force whose fighters flew an average of only one sortie per day in the campaign and whose bombers flew an average of only one sortie every four days. Thus, the allies were overwhelmed in the air, not by the number of German aircraft, but rather by a more effective ground organization. The failure of the French Air Staff to plan or organize for the broader requirements of technology was directly translated into extremely low readiness rates for French aircraft in May, 1940. Exact figures for aircraft operational rates are not available (another sign of French disorganization) for May, 1940 but a fair estimate from the numbers of aircraft that flew on missions is an average operational rate of about 50–60% for fighter units and no more than 40% for bomber units.[60] The French records of the campaign of 1940 are spotty but some French squadrons probably had no more than 40% of their aircraft available for operations before May 1940 and French military historians estimate a very low operational rate for the French Air Force at the height of the

60 See Charles Christienne and Pierre Lissarague, *A History of French Military Aviation* (Washington DC: Smithsonian Institution Press, 1986) p. 335.

battle in May 1940. The French Air Force consistently made group attacks with no more than 40–50% of the official group strength.[61]

The Flak corps proved to be tremendously effective in the campaign and the army after action reports noted the contribution of the large flak organizations to the campaign. Massed Luftwaffe flak forces, operating with the forward forces of the army, decimated whole Allied squadrons attacking the crucial bottleneck at the Meuse River crossing at Sedan on 13 and 14 May. Throughout the campaign, the Flakkorps I and II shot down 586 allied aircraft. [62] The other major contribution of the Flak force was in its role as direct fire artillery. The high velocity 88 mm flak guns were superb weapons for destroying bunkers and fortifications facing German troops. There were several cases in the campaign in which flak guns blasted a way through French and Belgian defense lines for the advancing German troops. Flak Korps I claimed 30 bunkers and fortified positions destroyed and Flak Korps II claimed 17 major fortifications.[63] Finally, the 88-mm Flak gun proved its effectiveness as one of the premier anti-tank weapons of the war. The two flak corps, which both put Luftwaffe flak units close to the front lines of advance, claimed a total of 326 Allied tanks destroyed or damaged during the 1940 campaign.[64] After 1940, the Luftwaffe would create more flak corps and the organizations saw extensive service in Russia where they excelled in both the anti-aircraft and ground support roles.

Other innovations made themselves felt in the 1940 campaign. In attacks against some of the outlying forts of the Maginot Line at Brisach, Stukas dropped the new 1000-KG armor-piercing bombs on the French bunkers. These proved fairly effective against even the strongest fortifications.

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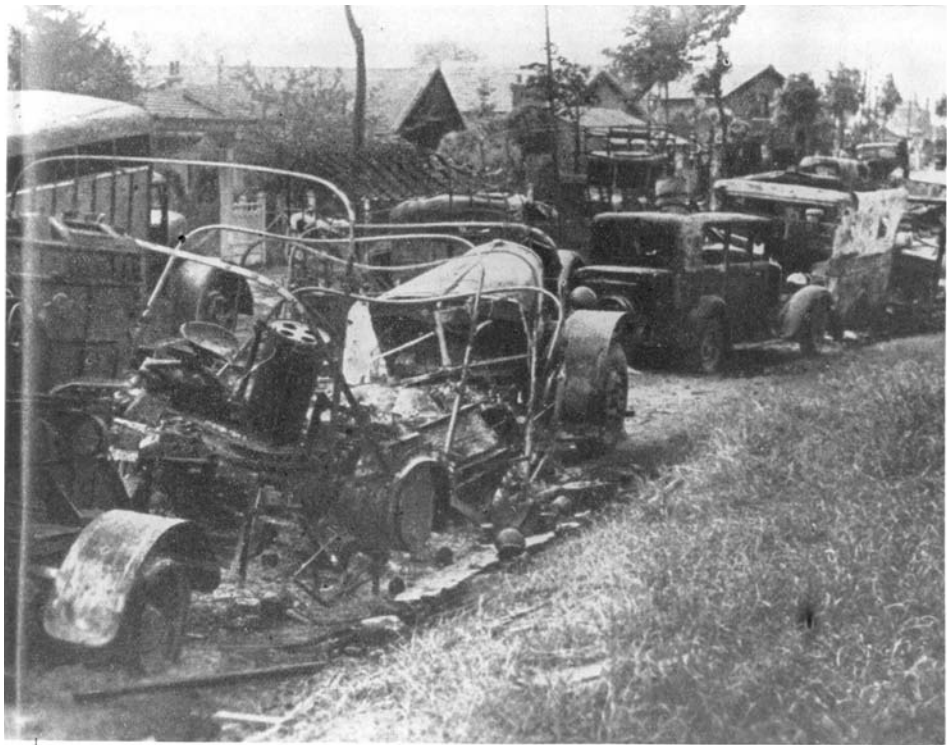
61 Williamson Murray, *Strategy for Defeat* (Maxwell Air Force Base: Air University Press, 1988) p. 43. See also Pierre Paquier, *l'Aviation de Bombardement Française en 1939–1940* (Paris: Berger-Levrault, 1948) See pp. 8-9 and pp. 208-235, for a log of French air activity between May 10-20, 1940.

62 Koch, pp. 42-43.

63 Koch, pp. 42-43.

64 Ibid.



Air view of attack on Allied column, France 1940 – USAF HRA

The most dramatic changes demonstrated in the battle for France were new tactics for the close air support units of the Luftwaffe. General Wolfram Von Richthofen proved himself to be the most innovative of the senior air leaders in this regard. Unhappy with the poor communication between the Luftwaffe and the army in the Polish campaign, Von Richthofen placed his own headquarters adjacent to the army headquarters that he was supporting. When a situation arose that required employing airpower, Von Richthofen or his chief of staff could confer with the army commander and chief of staff, make a decision and send dispatch aircraft to the front lines. In order to get a better picture of the ground situation, Von Richthofen put additional Flivo teams into armored cars in order to get them closer to the front lines. Throughout the campaign, the VIII Fliegerkorps kept one Stuka group and one Me 109 group for escort available at a forward airfield ready

for immediate takeoff. Good reconnaissance, better communications and close coordination with the army enabled Von Richthofen to make quick decisions to employ his forces in close support operations. Once the decision was given, the Stukas, covered by the Me 109s, would be in the attack within 45–75 minutes. By the standards of 1940, it was remarkably effective close air support.[65] It was a better performance than in Poland and it shows how hard the Luftwaffe had worked to learn the lessons of the Polish campaign.

The most dramatic operational innovation for airpower in the campaign came on 16 May, after Gruppe Kleist had crossed the Meuse at Sedan. The rapid advance of the German armored forces across the Meuse caused consternation in the German High Command as a gap had opened between the fast moving armored formations and the slow-moving infantry divisions that had the mission of protecting the flanks of the German advance. On 16 May Army Group Commander von Rundstedt ordered von Kleist to slow his advance in order to allow the infantry divisions time to catch up.[66] Von Richthofen, whose air corps had been providing support to the army's offensive in the north and to the forces advancing through the Ardennes since the start of the offensive believed that his forces should be concentrated to support Gruppe Kleist, who was conducting the primary German attack. Von Richthofen believed that the VIII Fliegerkorps could effectively protect the flanks of von Kleist's panzer force. On 16 May, von Richthofen convinced Reichsmarschall Goering to issue order directing the VIII Fliegerkorps to "follow Panzer Group von Kleist to the sea."[67]

The army initially doubted that von Richthofen could do well on his promise to protect the panzer divisions' flanks. However, as it became clear that the French would not mount another "miracle on the Marne", the High Command ordered the Panzer advance to continue. Von Richthofen directed his forces to screen and protect Panzergruppe Kleist's open flanks as their primary mission and to execute attacks in front of the panzer advance as the secondary mission.[68] Von Richthofen quickly did well on his promise to protect Panzergruppe Kleist's flanks. The reconnaissance units of the VIII Fliegerkorps spotted French divisions moving to

65 Speidel, *The Campaign for Western Europe*, Pt. 1, p. 181.
66 Alistair Horne, *To Lose a Battle: France 1940* (New York: Penguin, 1969) pp. 474-475.
67 Speidel, *The Campaign for Western Europe*, Pt. 1, p. 171.
68 Speidel, *The Campaign for Western Europe*, Pt. 1 pp. 185-186.

counterattack and relentlessly bombed troop columns, and French tank units that appeared on the German flanks. Von Richthofen's Stukas helped repel attacks by De Gaulle's 4th Armored Division at Montcornet on 17 May and on the 19th at Crecy-sur-Serre.[69] The Luftwaffe attacks on enemy tanks were rarely successful as direct bomb hits on tanks were rarely achieved and the Ju 87s and Hs 123s of the VIII Fliegerkorps carried no heavy cannon. However, the aircraft attacks separated the tanks from their supporting fuel and ammunition vehicles and inflicted heavy damage to the French infantry and artillery units.

The VIII Fliegerkorps carried out its mission of flank protection and close support very effectively. The French and British forces that threatened the German advance were decimated or, at least, thrown into confusion. The infantry divisions were granted enough time to move up and protect the Panzergruppe's flanks. Airpower, in the form of close air support and close interdiction, had proven to be a decisive factor in enabling the tremendous German victory in France 1940. The Germans had learned the effectiveness of interdiction attacks in Poland. That the flanks of rapidly-moving formations could be protected by airpower was a revolutionary concept for the evolution of ground warfare.

Conclusion

In the first part of World War II the Luftwaffe was a highly effective learning organization, and it was this ability to rapidly learn lessons and adapt that made the German victory against the Western Allies possible in the spring of 1940. In the Polish campaign the Luftwaffe had learned many key lessons, especially about conducting joint warfare. The Luftwaffe senior commanders, with a few key leaders such as Wolfram von Richthofen playing a central role, objectively looked at the many flaws in doctrine, organization and equipment exposed by the one month of hard fighting in Poland, and went to work to correct these failing in the six month period before the campaign in the West. At this stage of the World War the Western Allied military leaders present a model of incompetence in the top echelons. Despite having plenty of information, the senior British and French

69 Horne, *To Lose a Battle* 481,-82, 527-28.

military leaders took little interest in learning lessons, or in critically examining their doctrine and organization and training. there was little interest in testing doctrine or tactics through exercises. Unlike the Polish campaign, where the Germans held an overwhelming superiority and non one ever seriously doubted the outcome, in the West the Germans and Allies were evenly matched. Thus, the dramatic failure of the Western Allies in May–June 1940, and especially in their ability to use their air forces, lay not in any deficiencies in equipment, but solely in the cognitive sphere.

TECHNOLOGICAL DEVELOPMENT

HISTORY OF THE AIR FORCE OF THE CZECH REPUBLIC AND ITS STATUS IN THE 21ST CENTURY

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Abstract

Aircraft producers of the Czech Republic are well-known all over the world. The history of Czech aircraft production started at the end of the 19th century and it has continued into the present. During this time the construction of the aircraft and their production has been changed a lot; however nowadays there is a big question about the future cooperation between the Czech army and Czech aircraft producers and what is the future of the Czech Air Force.

Key words: aircraft producer, development of the Czech aircrafts, types of the aircrafts

History of the military aviation

The story of military aviation began immediately with the creation of Czechoslovakia. Several Czechoslovakian aircraft were confiscated after the collapse of the Austria-Hungary. This seizure of these aircrafts was not without its conflicts with the defeated troops of the Triple Alliance, mostly Germans and Austrians, who remained in the country after losing to the countries of the victorious powers.

At the beginning of the Air Force Czechoslovak volunteers and soldiers, who returned back to the territory of the Czechoslovak Republic, ensured the military's survival. But there were not an organizational structure and infrastructure in that

time. At the beginning of the Czech Republic the Air Force was involved in the fighting with the Poland, that claimed the area of the Těšínsko, and Hungary, that claimed the area of the southern part of Slovakia. The number and the type of aircrafts were dissimilar. The most common type of aircraft was the Brandenburg, which was used only for observation and touring flights.

The main position in the first part of the 20th century was taken by the France that helped the Czechoslovakian Air Force with reorganization and the formation. So this is the reason why was the Czechoslovak Air Force developed according the French model. Soon after France delivered 115 aircrafts for free. These aircrafts were already used, machines from a surplus of the supplies from the end of the First World War, especially SPAD fighter planes shows on *Figure 1-1* and the Salmson biplane long range reconnaissance aircraft shown on *Figure 1-2*.

Figure 1-1. SPAD fighter

Figure 1-2. Salmson 2A2

The other part of the delivered aircraft was represented by the surplus of the defeated armies of the Triple Alliance. These countries had to abandon their Air Force.

In February 1921 the Czechoslovakian Air Force had 253 aircraft in service. Of those machines only 7 were fighting-fit and 127 partially fighting-fit.

Local aircraft producers concentrated on the development of the Czechoslovak Air Force. At the beginning of their production producers focused on the foreign market and then they focused on the development of their own design of the aircraft. In the 20´s there were mostly constructions designed by Czechoslovakian engineers Smolík, Beneš and Hajn. The quality of Czechoslovakian pilots was really at a high level and their knowledge and skills were demonstrated mainly at foreign exhibitions. Particularly acrobatic pilot Staff Captain Malkovsky was one of the best pilots of the Avia BH-21 Czechoslovakian aircraft of the late 1920s. That time was the beginning of the Czech aerobatics.

In the following years, domestic production dominated over foreign production of aircraft construction. In the 20´s to 30´s the Air Force was gradually widened to 6 air regiments. However, the most numerous types of the aircraft were outdated B-534 biplanes (shown in *Figure 1-3)* that were produced during the period between the First and Second World War and that was designed by the Czechoslovak constructor F. Novotný.

Figure 1-3. B-534

In the second part of the 30´s it became obvious that the peaceful situation was threatened by Nazi Germany. The number of aircraft of the Czechoslovak Air Force was able to be equivalent with the Germany Air Force. But in that time Fascists introduced into service aircraft of the type BF-109 shown on *Figure 1-4*, which was unequalled by the B-534 biplane. At the same time Czechoslovakian engineers were inventing the B-35 aircraft, but it was still in the productive phase of the prototype.

Figure 1-4. BF-109

In March 1938, at the end of the free democratic Czechoslovakia, the Air Force owned 1630 aircraft of aviation technology with the largest representation being of the type B-534.

The period of huge development started After the World War II and with the help of the Soviet Union. In that time when all resolutions were made by politicians, Czechoslovakian engineers were on the top of the avionic branch with the jet training aircraft L-29 Dolphin shown on *Figure 1-5*, which was made by engineers Z. Rublič and K. Tomáš. The first flight of the prototype of this aircraft was on 5 April 1959. It was the first aircraft with the turbojet engine which was constructed and made by the Czechoslovak producer AERO Vodochody. This type of the aircraft was the best made product in the competition environment, where states of the Warsaw Pact took part. The civil version of this aircraft is still flying up to this day. The fact that 3500 examples of this aircraft were produced is the mirror of its high quality.

Figure 1-5. L-29 Dolphin

The next linked type of aircraft L-39 Albatros, shown in *Figure 1-6*, which was made by constructor Vlček, first took off in the year 1968. This type of aircraft was very progressive in comparison with L-29. The biggest innovation and progress was that in the construction of the L-39 was used the soviet engine from the airplane JAK-40.

Figure 1-6. L-39 Albatros

It was a AI-25TL by-pass turbojet engine. This aircraft was high-qualified and significantly states of the Warsaw Pact used it as a training and combat aircraft. The production of this type continued until 1990´s.

At this time Czechoslovak engineers were some of the best in the avionic branch. Czechoslovakian industry produced and constructed engines, whole airframes and systems. This production was comparable with the production in either the USA, France, Great Britain, or USSR. These states also developed ejection system, which could safely remove a pilot during extraordinary situations and flight regime from the aircraft.

Different versions followed (C, ZO, ZA, V, MS) and 60 L-59 aircrafts were sold to states of north Africa in the 1990´s. 2800 L-39 aircraft were made.

In the second part of the 1990´s the production of this type was reduced. AERO Vodochody responded to this situation by the innovation of the L-39/59 to aircraft L-159A shown in *Figure 1-7*. There were produced only 72 L-159 aircrafts. Alas, this low production did not cover the cost for development.

Figure 1-7. L-159 Alca

The other important types of aircraft are the series of the Zlín and L-410. Even after the dissolution of Czechoslovakia, Czech industry continued to develop.

Current status of the Czech Air Force

The biggest problem of these days is noncooperation with the states of the North Atlantic Treaty Organisation (NATO) that could help with the development of the new technology and aircraft. The development of the aircraft was financed by the aircraft factory or in another case by the Ministry of Defence. Nowadays, it is impossible to develop a modern structure of aircraft and modern Air Force without the deeper cooperation of the world powers. Aero Vodochody is the main producer of aircraft and the further development without the cooperation of the other states is improbable.

The Air Force has been deeply under financed. In this sector, we are faced with a lack of suitable spare parts, because there are not available new ones and old ones in warehouses are have been used. It is also strange that a democratic army draws from stocks that were made by the former regime.

The tradition of the education and upbringing in schools has been continuously declining. In the Aero Vodochody vocational school less and less professionals have been educated. This situation belongs with the gradual attenuation of production and the decreasing development of aviation experts. These professionals are replaced by computer specialists. The tradition of the aviation industry and transmission of the invaluable experience is the most important. The Ministry of Defence responded to the lack of aviation specialists by the reduction of the aviation branches and thereby impedes the development of prospective aviation specialists. The Air Service Engineering of the Czech Army is at a very high technical level, which is sometimes superior to the technical maintenance of the NATO states. In these states one person is usually doing one limited operation and does not know the whole process of the work. We can see it in international exercises and air shows, when around foreign aircrafts moves a large number of people. In the Czech Army these operations are carried out by a minimum number of employees.

The Concept of the Air Force points to the fact that the constant uncertainty and lack of concept resorts eventually in an outflow of experienced human resources. A decrease of allocation means that the raid hours of each aircraft is also decreased.

There are also new threats from states that profess Islam, which directly threatens states recognizing democratic principles. Although, for the Czech Republic there is no primary threat from these countries, the Czech Republic is none-the-less a member of NATO and it is obligated to give assistance to other states in the case of a threat. Here we have the fundamental problem that we are still dependent on a third party in the area of transportation, because the Czech Republic has not secured the global transport of the forces and resources.

The Czech Republic almost makes the same mistakes as perhaps did democratic regimes in the 1930´s. At that time funds for research and construction of the Air Force were being continuously reduced. Then there was a rapid occupation of almost the whole of Europe. However, that time Czech Republic owned a huge Air Force.

Currently Czech Republic owns 70 L-159 ALCA aircraft, including those that are stored in Aero Vodochody storage, it is about 48 aircrafts, 14 JAS-39 GRIPEN aircrafts that are not owned by the Czech Republic, and 4 airworthy L-39 ALBATROS ZA and a smaller number of helicopters: Mi-24, Mi-171 etc. Is it possible to compare this number with the last era of aviation?

Conclusion

There is still a question: "What can we expect from the future?" The future of the Czech Air Forces is uncertain, aircraft leasing agreements are about to expire and the question of whether modern supersonic aircraft will fly in the Czech sky is really unpredictable. Aircraft such as the L-159 A and T1 have enough time to repair so their existence is guaranteed. Although, this type is based on the proven design its operational capabilities are limited, because it is a subsonic aircraft, which cannot be compared with modern supersonic aircraft. Further development of the L-39 and L-159 series is unlikely. The future operation of the Mi-24 helicopters series is uncertain as well.

It seems that the future of the Czech Air Force is similar to the future of the Baltic States, where their sovereignty is guarded by other members of NATO. We are witnesses of the slow destruction of the Czech Air Force. Maybe we can see its end or maybe can we expect a better tomorrow?

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POSSIBILITIES OF MAINTENANCE IN FIELD CONDITIONS DESIGN

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Abstract

This paper introduces a container workshop project to perform the maintenance of The Czech Republic's land combat vehicles in field conditions. The presented workshop consists of two ISO 1C size range containers with special equipment. The first container is called a "working unit" and the other one is a "special purpose unit". During combat activities the containers would be arranged in an L shape with a rolled out roof. The article presents organizational and technical conditions connected with the implementation of the system of military equipment for temporary repairs for the military to ensure technical the support's functioning. Furthermore, the article mentions such issues as unification and the adjusting the equipment in the design and production processes, pro-active diagnostics, procedural conditionings, technology and temporary repair. Each issue is discussed considering possibilities and needs of the implementation of a temporary repair system.

Key words: logistics, operation system, field repairs of the military equipment, telemetry maintenance system, temporary repair, container workplace, battle damage repair kit, combat service support, maintenance of vehicles, field repair.

Introduction

The problem of unscheduled field repairs gains special importance in conditions of military operations during which the dominant source of equipment loss is combat and operational damage [1].

As the history and experiences of the last armed conflicts have shown, the enemy's use of modern agents of destruction is causing more and more military equipment losses [2]. In the case of an arming system, the significant part of the equipment damaged during combat operations is recovered and included in further operations thanks to its repair directly within the area of operations. This is a basic source of providing units with equipment; especially in the conditions of peace and stabilization missions [1, 3].

The temporary repairs process is executed in field conditions and consists of the following stages:

- range of damage assessment,
- selection and elaboration of damage repair technology,
- making a decision concerning the repair providing that the repair can be done in an appropriate time period,
- execution of the repair in field conditions or having the damaged equipment repaired in a parent unit or in a repair plant.

To make this process fully effective and to make the executed repairs low-cost, easy to perform, and sufficiently durable, the requirements described in the following chapters should be met.

Equipment Unification

The complexity of modern military equipment means that in the scope of maintaining its operational readiness, a number of undertakings, not only of a technical nature, must be involved. One must remember that armament systems are technical objects that have specific requirements essential to the execution of their tasks [4].

Executing equipment for field repairs can be more or less complex and time-consuming and in other words, it can be more or less expensive. Everything depends on the level of equipment preparation for the mentioned actions. That is, the equipment's susceptibility to field repair execution [4].

The susceptibility to temporary repairs is an ambiguous notion that is difficult to define. Undoubtedly, it is a component of maintainability, which is shaped mainly at the stage of constructing and producing an armament system.

The susceptibility to field repairs execution is a property of a device that describes its adaptation to repair work execution. The estimation of susceptibility to repair is high when an object is:

- designed keeping the modularity of assemblies,
- equipped with quick-mounting joints that provide quick assembly and disassembly.
- equipped with a possibility of using standard devices and tools in a process of assembly and disassembly,
- secured with base surfaces (openings) of the components in order to use them in a repair process,
- labelled in a way that enables easy and proper assembly of cooperative components of the object,
- constructed in a way that makes access to the most often damaged assemblies easy and, simultaneously, that enables easy mounting of damaged subassemblies or their repair without a necessity of disassembly,
- designed in a way that gives a possibility to use modern technologies and repair materials in a repair process,
- equipped with dedicated repair manuals in conditions of combat operations, and with special repair kits.

The especially significant element seems to be the modularity of assemblies together with the unification of parts, devices, and vehicles. The fulfilment of this parameter results in an easier and more available repair practice, as well as in adapting practices and repair kits to the whole family of vehicles or armoured fighting vehicles.

Proactive Diagnostics

Maintenance based on technical conditions was gaining importance in the past decades with the expansion of technical diagnostics. It is especially preventive in maintenance comprising of monitoring performance or parameters and of

consequential measures. Its main benefit resides in consistent removal of failures. Particular worn parts and parts or whole assemblies in the risk of failure are repaired or replaced optimally in advance. Thus, failure occurrence is prevented.

Proactive maintenance is considered another higher level of maintenance. It is completely based on the previous predictive maintenance which it further improves, so that its basis is the utilization of more complex technical diagnostics. Basically it is the top current version of predictive maintenance based upon the actual condition of the item operated. It is analysed in detail in the following chapter.

Proactive maintenance arose from the predictive maintenance type as especially a reaction to long-term findings that a certain group of failures repeats periodically upon clear causes. Known causes include mainly the following:

- Incorrectly organised maintenance work.
- Incorrectly performed maintenance (technical operation in the vehicle).
- Unqualified operators and maintenance personnel.

The proactive maintenance type is aimed at keeping inherent reliability of the vehicle at an acceptable level. As a source of information, technical diagnostics is utilized. The main objective of proactive maintenance is:

- Further reduction of maintenance and operational costs.
- Prevention of failure occurrence and thus extension of an interval to preventive maintenance, meaning extension of the vehicle's durability.
- Statistic control of accidental and systematic influences affecting the vehicle operability [5].

An important feature of the ER system is information about fault occurrence given as soon as possible. Knowledge of size and place of damage, as well as its impact on the further operation of military equipment, has a direct influence on further actions that aim at restoring the equipment's efficiency.

The modern military vehicles use the civilian technology based on the CAN (Controller Area Network) bus for data transmission. However, for the needs of NATO armies, the MilCAN system was created in 1999 dedicated to the newest and the most advanced armoured fighting vehicles manufactured in NATO states. MilCAN is a deterministic protocol in which the CAN bus can be used in the technology determined by the ISO 11898 standard. Although this protocol was developed initially for the management

system of the modern battlefield, the MilCAN is applicable wherever there is a requirement for deterministic data transfer.

An example of such a solution is the battlefield management system PBISA (Platform Battlefield Information System Application) used in the British Challenger II tanks, and a part of this system is a component of armoured fighting vehicle deck diagnostics (Fig. 1). Information generated by this component facilitates early detection and identification of faults; moreover, this information is of special importance for the temporary repair system.

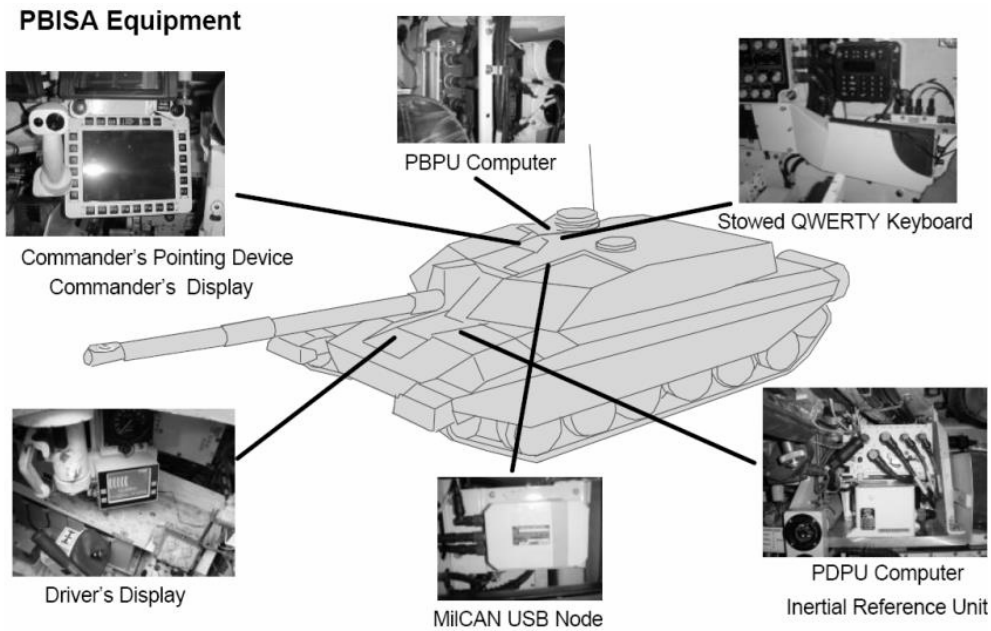


Figure 1. Components of battlefield management system of Challenger II tank [6]

The final element in the deck diagnostics system is its diagnostics interface. Military vehicles compatible with the OBD II/EOBD (On Board Diagnostic II/ European On Board Diagnostics) system have got a unified diagnostics interface in order to provide easier data transfer and a possibility to interpret fault codes by different scanners and other data-reading devices. An example of a Polish armoured fighting vehicle equipped with the deck diagnostics system is the AMV Rosomak, whose system is compatible with OBD II/EOBD.

The latest trend in the maintenance area is so called "telemaintenance", which may be explained as remote- controlled maintenance employing the proactive maintenance principle. In some publications, the term "Remote Diagnostics & Maintenance (RD&M)" is used [5]. It is based on the wireless transmission of technical data about the vehicle. The main field of its utilization is in companies specializing in long-distance transportation and also in the military environment. This method enables on-line monitoring of parameters upon sensors integrated in the vehicle and the wireless transmission of the information to a remote computer. This is very helpful especially for securing missions on a foreign territory.

Telemaintenance may be divided into the following four levels:

1. Diagnosed vehicle with a driver.
2. Support logistics centre where computer processed diagnostic information is located.
3. Experts performing the maintenance on the vehicle.
4. Vehicle manufacturer who supplies a technical database including drawings and technological procedures for maintenance [5].

Figure 2 shows a schematic telemaintenance system based on the wireless transmission of diagnosed data from the vehicle to the telemaintenance logistics centre and to the vehicle user. The vehicle electronic control unit makes performance indicators and error codes accessible for analysis; these are sent to the logistics centre. There, in the case of error messages an advisor informs the driver about the problem severity and advises on possible problem removal or provides necessary service support.

It means that the advisor ensures the vehicle maintenance or field repair with the use of a mobile workshop, or arranges maintenance in the maintenance and repair centre. If necessary, the logistics centre communicates further with the vehicle manufacturer who supplies the centre with new data materials for particular vehicle types.

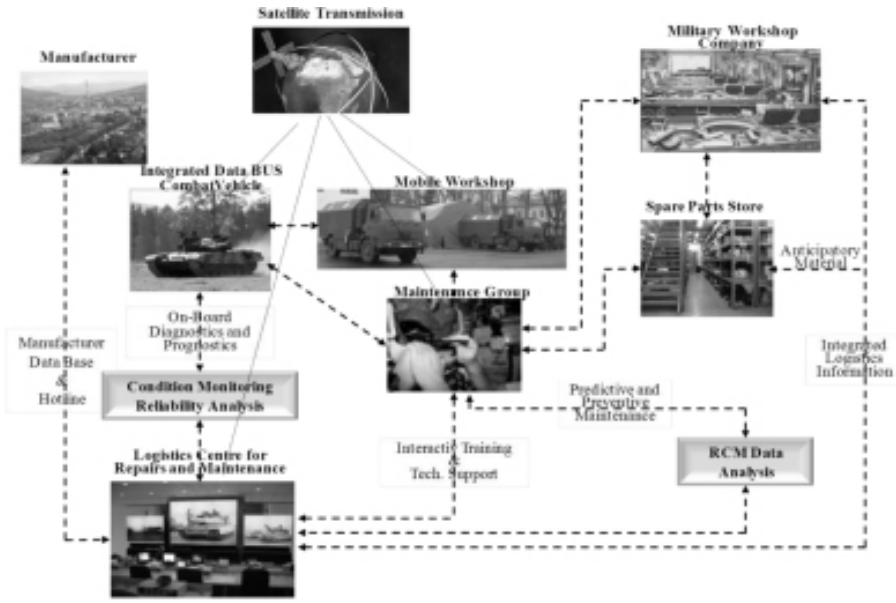


Figure 2. Design of telemetry maintenance system in battlefield [5]

Design of a Container Mobile Workshop

General description of a container mobile workshop

Determination of a container mobile workshop

A wheeled container workshop (a functional module) along with a special tool store is designed for repair levels 2 and 3, namely:

- the chassis of the car model range Tatra (815, 810),
- the chassis of the automobiles Land Rover etc.,
- the chassis of the wheeled armoured vehicles PANDUR II, Dingo and Iveco.

A tracked container workshop (a functional module) along with a special tool store is designed for repair levels 2 and 3, namely:

- the tracked combat vehicles BVP and T-72 M4CZ.

The crew structure and the technical skills of the crew members are selected according to the types of supported combat vehicles and can change. For this workshop we recommend a 6-member crew consisting of a crew leader - an auto mechanic – a welder, a senior auto mechanic, an auto mechanic – a welder, a senior mechanic, a senior auto electrician, and a senior electrician [7], [8].

Standardized workshop solution

The container workshop is made from two pieces of ISO 1C size special containers arranged in an L shape (Fig. 3).

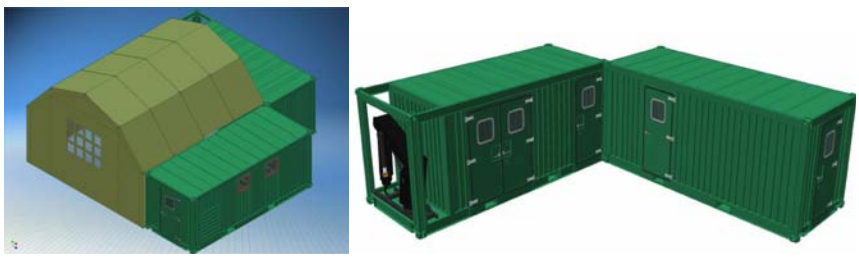


Figure 3. A container workshop project arranged in an L shape

The workshop consists of two container workshops. First the workplace is created with the working module which is universal for the maintenance of tracked and wheeled combat vehicles. The working module is placed in one ISO 1C container and is heat insulated with sandwich panels. The second workplace is created with the functional module then might be used for the maintenance and the repair of wheeled combat vehicles as well as tracked combat vehicles depending on internal facilities which might be changed according to the kind of supported vehicles. In the ISO 1C container there is a special tools ì store which is actually a functional module equipped according to the kind of supported combat vehicles. The tools might be combined, where appropriate. In certain situations the module can be equipped with extra tools used for the maintenance and repair of armaments, communication equipment, etc. An outdoor workplace intended for the repair of land combat vehicles is designed with a roof which might be rolled out in the space between the containers, see Fig. 3.

The body of containers will be welded using steel sections and trapezoidal metal plates which will make a covering for the containers. The upper and bottom corner container elements of ISO 1C size will be built into basic bodies. The container panels themselves (peripheral and roof ones) will be filled with 40 mm thick insulating sandwich panels made of Elastopor SH 226/003 polyurethane foam which has been authorized for use in the Army of the Czech Republic after long-term tests. As for the covering material of insulating panels, it will bea 0,8 mm thick surface-modified aluminium plate.

A container floor will be made from isothermal floor panels with plywood, and covered with anti-slip PVC. The floor panels will be filled with the same Elastopor SH 226/03 polyurethane foam. The floor panels will be 50 mm thick. Entry doors to the containers will be equipped with a special door lock with the possibility to be locked by locks, and rigid clips for sealing.

The general external dimensions of 1C container are standardised. The mass of projected workshop modules will be as follows [7], [8]:

1. A working module
   a) service weight..... 3 000 kg,
   b) effective weight.....up to 16 500 kg,
   c) total weight..... 19 500 kg.
2. A special tools store–a functional module
   a) service weight..... 2 730 kg,
   b) effective weight.....up to 22 000 kg,
   c) total weight..... 24 730 kg.

<u>The workshops can be used for work [7], [8]:</u>

a) in mild climate zones, i.e.
   – in the areas of average monthly temperatures from -15 °C to 25 °C,
   – with the lowest temperatures rarely below -32 °C, and the highest rarely above 44 °C,
   – with extreme temperatures of -40 °C and 50 °C,
b) with relative air humidity up to 90% and a temperature of 33 °C,
c) with air dustiness up to 1,5 $g \cdot m^{-3}$ taken 0,5 m above the ground level,

d) with the speed of air flow up to 20 $m \cdot s^{-1}$,
e) with atmospheric precipitation such as rain, snow and hail,
f) at above sea level up to 3000m (up to 4000m for a short time).

Providing that fuel supplies are big enough to allow for:

a) heating operation for 48 hours,
b) power source function for 20 hours,
c) hot-air heating operation in a workshop tent for 10 hours.

The requirements regarding the work in a workshop are as follows:

a) the concentration of harmful substances will not exceed during 12-hour work 20 mg/m^3 of carbon monoxide, 200 mg/m^3 of oil fumes, 70 mg/m^3 of petrol fumes, and 0,3 mg/m^3 of sulphuric acid fumes,
b) there will be provided natural light as well as artificial light in the workshop,
c) the workshop will be equipped with lamps for main, spare, local and cover illumination according to the ČSVN 83 960,
d) the illumination level will be at least 50 Lx in the check points 1m off the ground and 0,5m off the wall. The most illuminated place to the least illuminated place ratio will be bigger than 1 to 3,
e) the illumination of the workplace in a tent will be provided with a 230 V portable illuminating set with a screening slide.

For concealing the container workshop a camouflage net of 12 x 15 m is used with supporting components and needles. In order to fasten a camouflage cover, the containers are on the sides equipped with clips for supporting components holding stability against wind. It takes approximately 20 minutes to conceal the container, and 15 minutes to remove the camouflage.

The equipment of a working module and a functional module

The equipment of a working module designed for the maintenance of wheeled and tracked combat vehicles

Working module was divided into two basic rooms (Fig. 4):

1. Sealed (work-related) – is the main room for a functional workplace where work might be done.
2. Non-sealed (technological) – is the room intended for placing basic technological equipment consisting of the filter and ventilation plant FVZ 98, the air handler K 4A, the independent hot air heating D5LC, sources and electric and light distribution [7], [8].

Figure 4. Top view of a working module designed for the maintenance of land combat vehicles

The equipment and main parameters of a functional module designed for the maintenance of wheeled or tracked combat vehicles

In the functional module we suggest putting the equipment used for welding by a welding arc, and charging accumulator batteries; a set for gas welding (1 acetylene bottle, 2 oxygen bottles, a bottle trolley, a welder set); a tent fly; portable oil firing; drive-up ramps, crane facilities (suspension tools), a hydraulic jack for 8 tons and 25 tons; expendable supplies and selected spare parts.

Apart from that, there is in the functional module a hydraulic swing crane placed at the front wall of the container to the left of an entry door. It is fixed on a special traversing bridge. The extending out and retracting of the crane is done by a linear hydraulic motor connected to the crane's hydraulic circuit. Two linear hydraulic motors providing the stability of the crane in a protruded position, they are also will be connected to the hydraulic circuit [7], [8].

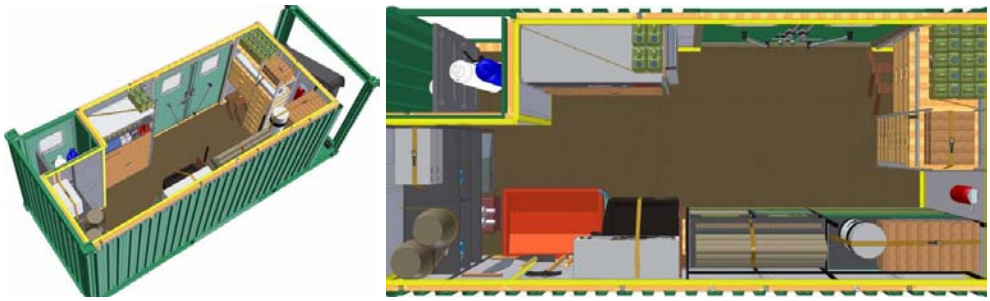


Figure 5. Top view of a functional module designed for the maintenance of land combat vehicles

In the functional module it is advisable to place also a set of coupling and suspension tools used for manipulating the systems and subsystems of the supplied technical equipment when dismantling and assembling vehicles. The tools are chosen from the unified set introduced within the Army of the Czech Republic.

In the mobile container workshop we suggest putting also the sets of battle damage repairs kits such as: metallurgical material, connection accessories, electrodes for electric arc welding, welding material for flame welding, soldering process, adhesives materials and materials used for repairing tire tubes and tires.

Principles of Temporary Repairs

According to Alliance documents „temporary repair is repair, which may be temporary, to restore equipment to a specified condition by non-conventional/improvised repair, both deployed and in-barracks, bounded by legal constraints" [9]. Similar formulation of the problem was presented in European Standard EN 13306 [10] where it is said that temporary was defined as: „physical actions taken to allow a faulty item to perform its required function for a limited time interval and until a repair is carried out". In the past the temporary repairs of military combat vehicles proceeded spontaneously and depended on the circumstances to be dealt with. The repair progress was influenced by experiences, the level of combat

vehicle complexity, technical facilities and individual skills. Applying a different technology, using a reproduction part, or performing a repair by a serviceman without the competence are typical features of temporary repairs.

Theoretical principles of temporary repairs

It is good to realize that the temporary repair of combat vehicles cannot adequately substitute the repair performed in compliance with technical conditions and that is the reason why the next repair should be carried out in the shortest time frame. The reason for performing a regular repair is that a nonstandard procedure does not provide for dependability. In spite of all drawbacks, temporary repairs can play an important part in a combat operation.

a) Temporary repairs in peace time

The aim of a temporary repair in peace time is to renew or partly renew mobility and to prevent from more extensive damage, as for example environmental pollution caused by the leak of hazardous substances, safety threat by causing trouble in operation, or the devaluation of a transported material.

Operating costs are not expected to be increased due to the temporary repair, therefore, when deciding whether to perform it, the economical factor will be the main criterion. The economical factor can be expressed by the following formula [11]

$$N_O + N_{DO} + N_{ZtDO} \leq N_O + N_{ZtO}, \tag{1}$$

where N_O – the costs of performing the repair, N_{DO} – the temporary repair costs, N_{ZtDO} – the loss incurred by the time the temporary repair is performed, and N_{ZtO} – the loss incurred by the time the repair is performed.

The loss can include the costs of the settlement of a possible breakdown, the devaluation of a transported material, penalty payments, repair assistance, the costs of reloading material, the recovery and evacuation of a vehicle, or the increased costs of the repair due to damage caused by performing the temporary repair. After modifying the equation (1), we get [11]

$$N_{DO} \leq N_{ZtO} - N_{ZtDO} \tag{2}$$

which is an economical requirement for performing the temporary repair. However, even the much higher costs of performing the temporary repair as compared with the repair costs might be justified in this way, therefore the following formula must apply simultaneously

$$N_{DO} \leq N_O \tag{3}$$

and then it holds

$$(N_{DO} \leq N_{ZtO} - N_{ZtDO}) \bigcap (N_{DO} \leq N_O). \tag{4}$$

When deciding whether to perform the temporary repair, we should take into account not only the costs, but also the fact of what extent a vehicle or a workshop vehicle is equipped with tools and material, to what degree a vehicle can be adapted to temporary repair performance, and the level of operating personnel skills.

Another important factor used when we are to agree on performing the temporary repair is time t_{min}, during which it is necessary to assure the main function of a temporarily repaired part until a regular repair is performed. The information stated above is followed by a requirement limiting the costs of temporary repair performance

$$N_{DO} \leq t_{\min} \frac{N_{ZtO} - N_{ZtDO}}{\mathrm{d}t}. \tag{5}$$

Therefore, when deciding whether to perform the temporary repair in peace time, it holds [11]

$$(N_{DO} \leq N_O) \bigcap (N_{DO} \leq t_{\min} \frac{N_{ZtO} - N_{ZtDO}}{\mathrm{d}t}). \tag{6}$$

b) Temporary repairs in field conditions

The difference between the temporary repair of combat vehicles performed in peace time and in field conditions is that we follow not only economical factors which are the most important in peace time, but also the provision of combat vehicle main functions, e.g. a weapon system, vehicle mobility and communication. The survival time of a vehicle (a crew) in a battlefield is crucial for deciding whether to perform the temporary repair. To put it simply, the recovery process of combat vehicle fighting power might be viewed as a geometric sequence [11]:

$$n_t = n_0 q^{t-1}, \tag{7}$$

where n_0 is the number of combat vehicles before the operation began, n_t is the number of combat vehicles at the beginning of the day t, q is a sequence quotient, t – the number of days.

The magnitude of the sequence quotient q can be described as the ability to repair damaged combat vehicles with the extension of loss z, combat vehicle repairability ψ, and when considering the capacity and technical possibility of performing the repair with repair units ε.

Therefore

$$q = 1 - z + \psi\varepsilon z. \tag{8}$$

Then, sustainability time is given by a decrease in the number of combat vehicles at an acceptable level n_x

$$n_x = n_0 \cdot q^{t_x - 1} \tag{9}$$

and therefore

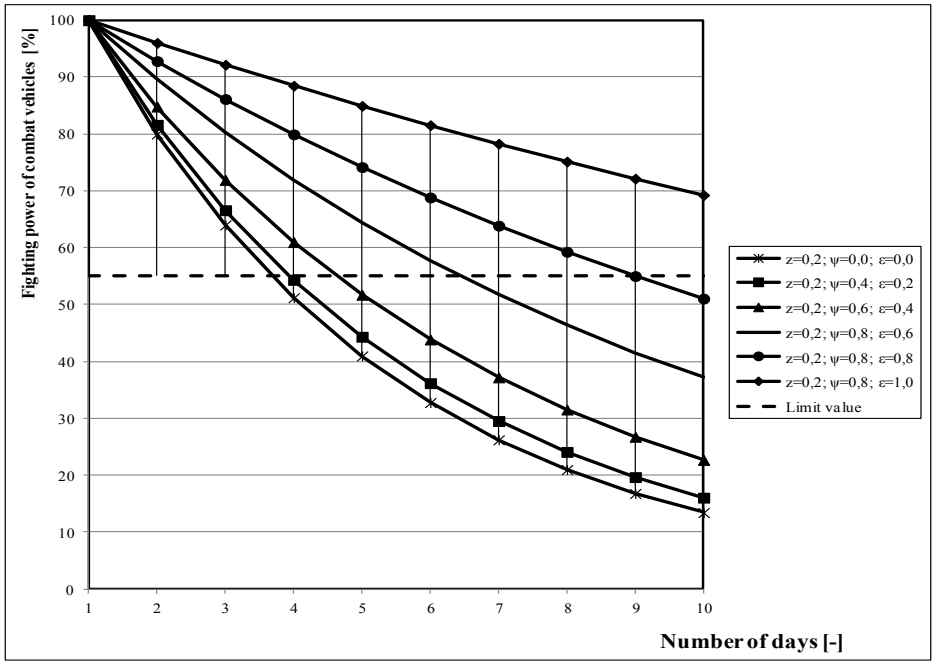
$$t_x = \frac{\log n_x - \log n_0}{\log q} + 1, \tag{10}$$

when reaching the time t_x a unit must be replaced or supplied by another combat vehicle [11].

Performing temporary repairs helps to increase the capacity of repair units by labour saving, overcoming downtime due to the lack of spare parts, or involving crews in the repair process. This will be manifested in the rise in the coefficient value ε.

Graph 1 shows the courses of the decrease in fighting power with average of 20% daily losses z, the limit of 55% fighting power and different magnitudes of ψ and ε.

The courses of single curves show that extending the capacity of repair units has a positive impact on the fighting power time of supplied units, e.g. when performing temporary repairs.



Graph 1. Fighting power of combat vehicles with 20% daily losses

Temporary repairs technology

The aim of a temporary repair system is to increase the level of professional personnel and workshop specialist readiness for the recovery of combat vehicle fighting capacity and to prepare the means of logistic support to provide this repair.

The system takes into account the development and verification of technologies which can be used for performing temporary repairs including their material support. The temporary repair system should be targeted, at well-arranged, technological procedures focused on the temporary repairs of important nodes with labour input time evaluation, necessary tools and material [11], [12].

We suggest that general procedures are to be subdivided per systems or parts common for combat vehicles. In the text below there is a division scheme and the possibilities of performing temporary repairs [11].

Tanks

- smaller ruptures and leaks which might be fixed by bandaging or cementing with the use of fast-setting two-part sealants,
- disruptive breakdowns which might be repaired through a combination of bandages and packing, or packing made of different material,
- damaged tanks which might be replaced by connecting barrels, canisters or heat resistant cases capable of being closed with a specific medium.

Condensers

- leakage which can be stopped using substances added to a cooling liquid which solidify during the leak from a cooling system, or fast-setting sealants used in the place of the leakage or nearby,
- disruptive breakdown which can be fixed by squeezing a tube with pliers and then filling the hole with a sealant or hot lead,
- damaged condenser which can be isolated for a short time and a cooling system might be interconnected without the condenser, or the condenser may be replaced by another part, e.g. a barrel or a demountable fuel tank.

Pipe

- minor damage and the leak of a low-pressure pipe which might be repaired by bandaging or using two-part workable sealants,
- more serious damage to a low-pressure pipe (not including exhaust pipes) which can be solved by replacing a damaged part with a rubber hose fastened with a sleeve or a band,
- damage to a high-pressure pipe which can be mended by pipe's offset and cementing the ends with anaerobic sealants, or by completely replacing the pipe using a high-pressure hose with endings.

Air and hydraulic systems

- damage to the part of a system which might be disabled by the blanking of a particular part, or providing a by- pass around a damaged part using hoses with endings.

Rods and shafts

- cracked rods can be joined by a thicker bond sheet metal, the ends of which will be drilled and screwed together, or there will be used a sleeve welded at the end,
- cracked shafts will be joined by welding to a sleeve where applicable.

Windings

- minor damage can be mended by using a threaded coupling with an anaerobic sealant,
- damaged internal thread might be fixed by drilling off and using threaded insets which renew the original winding.

Electric cables

- visible local damage might be repaired using insulation with both ends twisted and insulated by an insulation tape, or the joint is welded,
- damage difficult to detect can be fixed by bridging a proper circuit using a new cable, or, in the case of power supply, by connecting with a cable assembly with nominal voltage.

The design of a Battle Damage Repair Kit of Land Combat Vehicles in Field Conditions

Repairs of land vehicles under field conditions are not only accomplished by using the mobile workshops but also by the use of temporary repairs. A similar formulation of the problem was presented in European Standard [10], where it is said that temporary repair is defined as: „physical actions taken to allow a faulty item to perform its required function for a limited time interval and until a repair is carried out".

We proposed the implementation of a battle damage repair (BDR) kit (Fig. 6) for the temporary repairs in the Czech Army. The dimensions of a BDR kit bag are 50 x 32 x 15 cm and its weight is 8.1 kg. The bag is divided in to three separate boxes, in which the material for the temporary repairs of the land vehicles is placed. The

first box contains adhesives and cements. There are tubes, adapters, connectors and plugs in the second box. In the third box there is material for repairs of the land vehicles electrical systems, for instance shielding, wire, crimping pliers, tin solder etc.

Figure 6. Battle damage repair kit for repair land combat vehicles

Conclusions

This paper presents the project of the container workplace designed for the maintenance of wheeled and tracked combat vehicles in field conditions. The quick and cheap replacement of functional module equipment according to the type of supplied technical vehicles is one of the advantages of this project. With replacing internal facilities, the wheeled version module might be changed into the tracked one and vice versa. Using a unified workplace module for the maintenance of both wheeled and tracked combat vehicles is another advantage of the project. The real benefit of the project lies in achieving unification and reducing the number of mobile workshops within the Army of the Czech Republic, because at present there are about 80 kinds of them.

The analysis conducted within the framework of the paper concerning possibilities and needs' analysis in a scope of armed systems' temporary repairs' implementation allows for the formulation of the following conclusions:

- The military equipment temporary repairs executed directly in the operation area can be a significant source of retrieving damaged military technology and has a direct influence on the combat ability of forces.
- Armed systems' survivability and field repairs should be formed already at the stage of equipment designing and manufacturing.

- Procedural conditionings are essential with regard to executing repairs directly in operational areas. Equipment operation and instruction procedures must precisely determine the possibilities of using temporary repairs in the particular circumstances, which can ultimately contribute to further damage but still, it enables the unit to complete a task or even to save human life on the spot.
- To implement temporary repair system effectively, a trained and experienced staff, having proper equipment and repair materials, is essential.

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THE ANALYSIS OF THE ACOUSTIC WAVE VELOCITY ON THE TARGET LOCALIZATION ACCURACY

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Abstract

The accuracy of target localization using acoustic methods depends on atmospheric conditions. The acoustic wave velocity varies with fluctuation of atmospheric temperature, presure and humidity. Therefore, a mathematical model for the description of acoustic wave velocity on target localization accuracy has been described. The results are presented and commented upon.

Key words: Target; Location; Acoustic wave; Wave velocity; Atmosphere; Humidity; Temperature.

Introduction

The enemy's target detection using acoustic methods is closely connected with the problems of the transmission channel – the atmosphere in this case. The information about the target can be widely improved by solving the problems connected with the transmission channel behaviour and target acoustic characteristic. The description of the acoustic wave propagation is usually linked to the neglecting of the atmosphere (transmission channel) characteristics. Alternatively the resultant data are only partially corrected.

Spatial atmospheric influence on acoustic wave propagation

The attenuation of the acoustic wave in the atmosphere depends on air composition with the significant influence of water vapour concentration. According to ISO 2533 the standard atmosphere, defined as a clean and dry air at sea level, consists of 78.084% of nitrogen, 20.9476% of oxygen and 0.0314% of carbon dioxide. The remaining percentage, e.g. 0.937% of the dry air pertains to trace elements that have no effect on acoustic wave attenuation. The said air composition is assumed up to 50 km above sea level for default calculation of the atmospheric attenuation. However the water vapour concentration varies in a wide spread. The water vapour concentration 10km above sea level can be 100 times lower than at sea level.

The increase of the acoustic pressure amplitude of the harmonic tone propagating through the atmosphere is described as an exponential increase characteristic. Thus for the current acoustic pressure amplitude p_t at the distance s the following is valid [6]:

$$p_t = p_i.\exp(-0{,}1151.\alpha.s) \quad . \tag{1}$$

Where p_i is an initial acoustic pressure amplitude, α is an attenuation coefficient and 0.1151 = 1/[10 log(e^2)].

The attenuation of the atmosphere $\delta L_t(f)$ [dB] for harmonic tone with frequency f is than defined [6]:

$$\delta L_t(f) = 10.\log(p_i^2 / p_t^2) = \alpha.s \quad . \tag{2}$$

In agreement with Avogadro's law, the molar concentration of water vapour is equal to the ratio of partial water vapour pressure to atmospheric pressure. The water vapour molar concentration ranges from 0.2% up to 2% for normal conditions at sea level. However it increases under the 0.01% for the high over 10km above the sea level.

The atmospheric attenuation, according to [6], is a function of two frequencies of relaxation: the oxygen frequency of relaxation f_{rO} and the nitrogen frequency of relaxation f_{rN}. The values of said frequencies are determined by the following equations:

$$f_{rO} = \frac{p_a}{p_r}\left(24 + 4{,}04.10^4 h \frac{0{,}02 + h}{0{,}391 + h}\right) \tag{3}$$

$$f_{rN} = \frac{p_a}{p_r}\left(\frac{T}{T_0}\right)^{-1/2}\left\{9 + 280.h.\exp\left[-4{,}17.\left(\left(\frac{T}{T_0}\right)^{-1/3}\right)\right]\right\}. \quad (4)$$

The coefficient of attenuation caused by the atmosphere α [dB] is expressed by:

$$\alpha = 8{,}686 f^2\left\{\left[1{,}84.10^{-11}\left(\frac{p_a}{p_r}\right)^{-1}\left(\frac{T}{T_0}\right)^{1/2}\right] + \left(\frac{T}{T_0}\right)^{-5/2}.\left[0{,}01275.\left(f_{rO} + \frac{f^2}{f_{rO}}\right)^{-1}\exp\left(\frac{-2239{,}1}{T}\right) + \right.\right.$$
$$\left.\left. + 0{,}1068.\left(f_{rN} + \frac{f^2}{f_{rN}}\right)^{-1}\exp\left(\frac{-3352{,}0}{T}\right)\right]\right\}. \quad (5)$$

Equations [3] and [5] are sufficient for the determination of the coefficient of attenuation of harmonic tones propagating though the atmosphere, the temperature of which is T; In fact the atmosphere is an acoustic atmospheric filter.

Generally, the dependence of the speed of sound c [m s^{-1}] on air temperature t [°] can be expressed as [3]:

$$c_1(t) = 331\sqrt{1 + \frac{t}{273}}\ , \quad (6)$$

or

$$c_2(T) = 343{,}2 * \left(\frac{T}{T_0}\right)^{1/2}, \quad (7)$$

where T_0 = 293.15K. Another method for the speed of sound calculation is [2];

$$c_3 = 331{,}57 + 0{,}607t \quad (8)$$

The expressions [6,7,8] neglect the minor effect of water vapour on the speed of sound. The water vapour influence on the speed of sound is negligible and is less than 0.3%.

The graphs of the speed of sound determined by expressions [6, 7 and 8] are presented in Fig. 1. The maximum difference of the computed speed of sound is less than 2.2 m s^{-1} and is valid for a temperature over 60°. It can be seen that the higher the temperature, the higher the speed of sound. The speed of sound is a function of the current atmosphere condition, e.g. atmospheric temperature, atmospheric humidity and atmospheric pressure.

The effect of atmospheric humidity is corrected by the using of virtual air temperature. The description of virtual temperature computation is described in [6]. Virtual temperature determination is based on the evaluation of the temperature of clear air, the density (grossness) of which is the same as the density of no clear air.

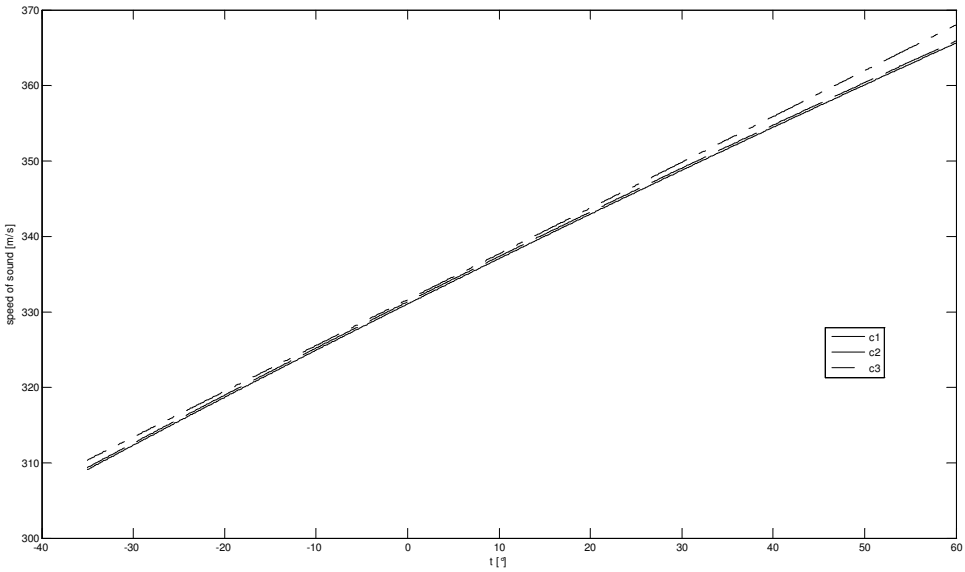

Figure 1. The speeds of sound determined by expressions [6,7,8]

The effect of speed of sound on target localization accuracy

At least three acoustic receivers (microphones) are necessary for target localization. Four microphones (moveable acoustic sensor system) in line were used in the mathematical model (see Fig. 2).

The target localization is based on a comparison of the signals from all four microphones. The distance d_{csi} of i^{th} microphone to the target is:

$$d_{csi} = vt_i = \sqrt{(x_i - x_c)^2 + (y_i - y_c)^2} \tag{9}$$

where t_i is transition time of the sound wave from the target to the i^{th} microphone, v is current speed of sound, (x_c, y_c) and (x_i, y_i) are target resp. microphone coordinates.

The target location is based on computing the time difference of the arrival (TDOA) Δt_{ij} of a sound signal emitted from the target to the single receivers. The estimation of the target coordinate accuracy depends on both time TDOA measurement accuracy and local variations of the transition channel. The example of the acoustic signal records on four single receivers is presented in Fig. 3. The 1520mm self-propelled howitzer was the signal source. The single time of arrivals are marked and printed above the graph.

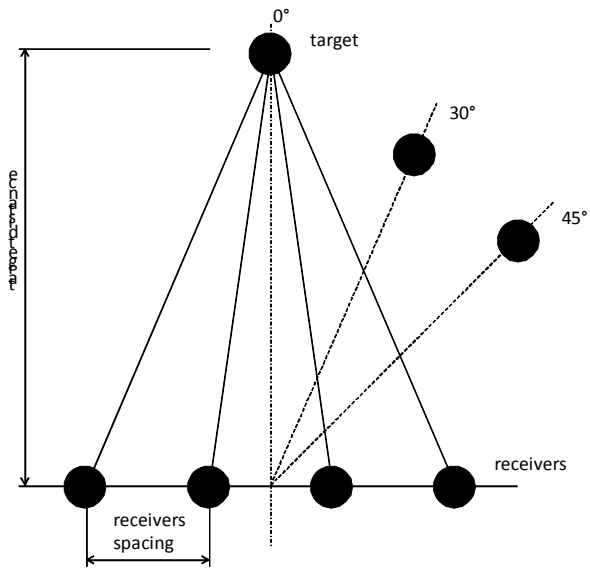

Figure 2. Target and receivers arrangement

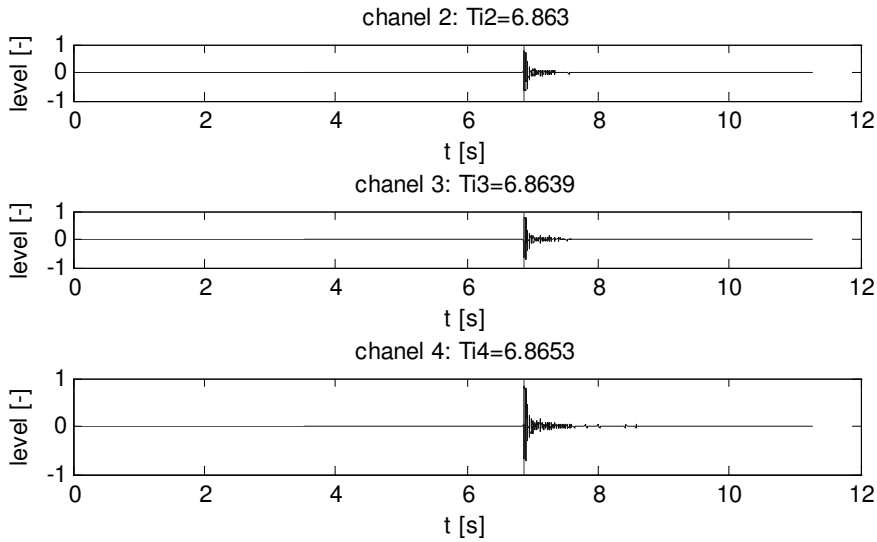

Figure 3. Acoustic signal records

The speed of sound was considered as a random variety that obeys a normal distribution. The parameters mean and variance were determined in the following way: the mean was calculated according to [9] for specific temperature. The variance was set $\sigma^2 = 1\ ms^{-1,}$ which is a sufficient value (see chapter 2). A thousand executions of location computation were done for specific temperature and receivers and target arrangement. The output (resultant target location coordinates) was compared with the input (real target coordinates). Thus the population mean and population variance of the set of target location coordinates were computed (for x and y coordinate). The example of computation results can be seen in Fig.4–8.

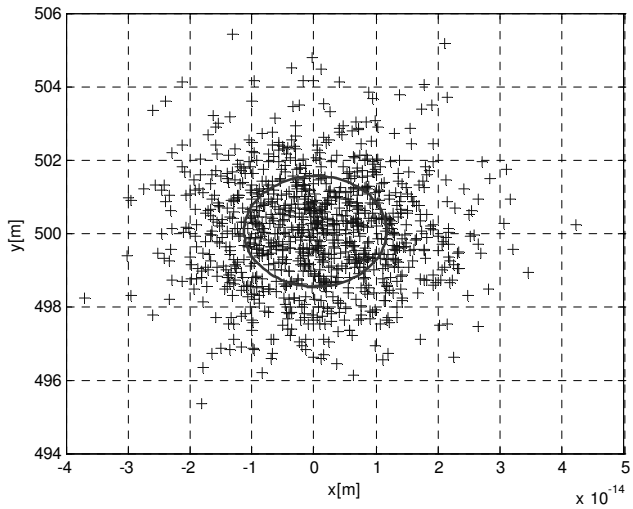

Figure 4. The position of target in distance 500m, position 0°, μ_x = 2.19. 10^{-16} [m], μ_y = 500,05 [m], σ_x = 1.14. 10^{-14} [m], σ_y = 1.51 [m] with ellipse of standard deviations

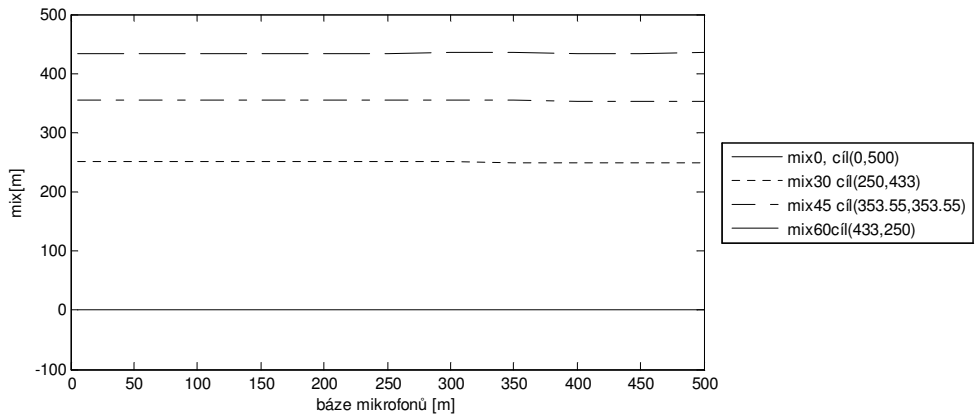

Figure 5. The mean μ_x for microphones base b= (0.01 až 1D) [m], distance D=500 m, target position regarding to microphones line (0°, 30°, 45°, 60°)

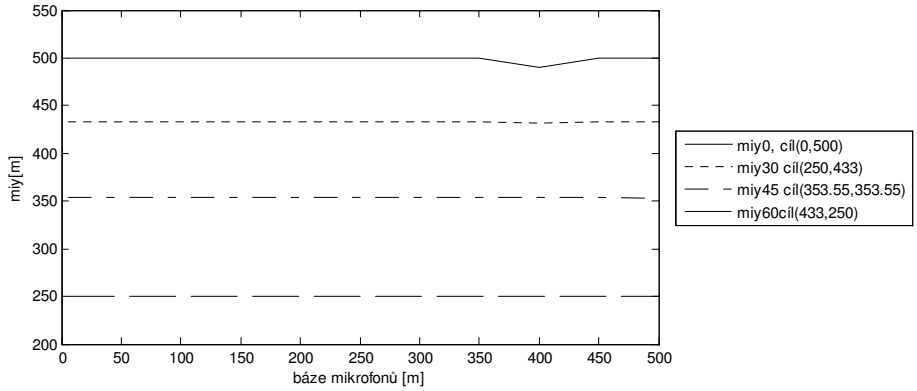

Figure 6. The mean μ_y for microphones base b= (0.01 až 1D) [m], distance D=500 m, target position in relation to microphone lines (0°, 30°, 45°, 60°)

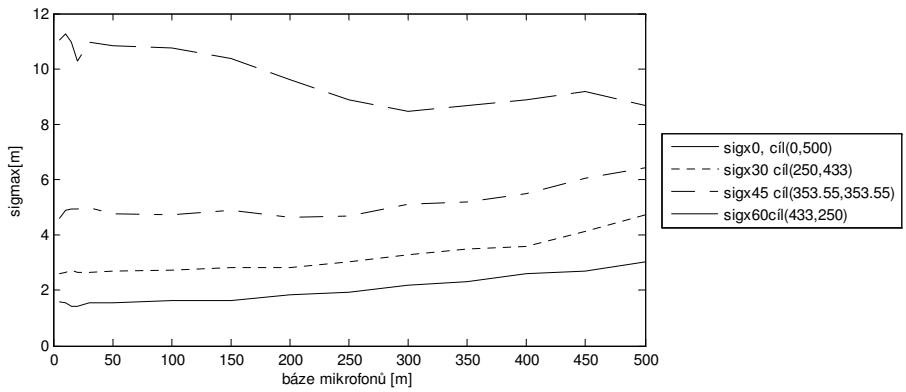

Figure 7. The standard deviations σ_x for microphones base b= (0.01 až 1D) [m], distance D=500 m, target position in relation to microphone lines (0°, 30°, 45°, 60°)

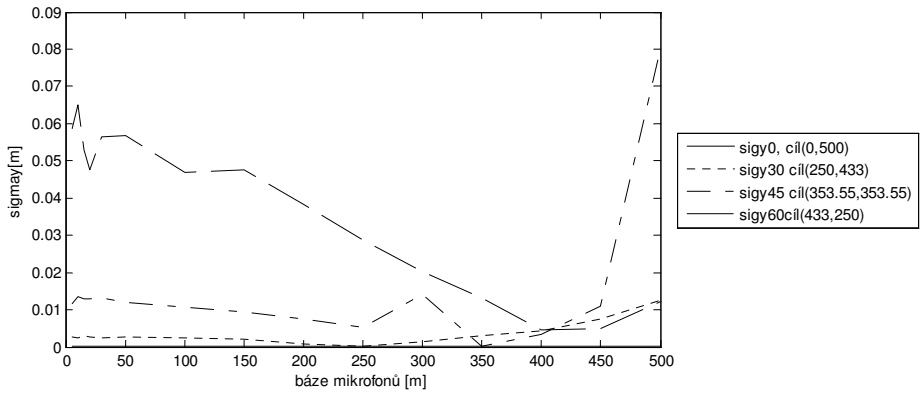

Figure 8. The standard deviations σ_y for microphones base b= (0.01 až 1D) [m], distance D=500 m, target position in relation to microphone lines (0°, 30°, 45°, 60°)

Conclusion

Pursuant to the analysis presented here, it can be mentioned that variations to the speed of sound effects the target location minimally. An error in x-coordinate determination is significantly greater that an error in y-coordinate determination. The article was created in the conceptual Research project No.402 of Faculty of Military Technology.

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REPORTS AND REVIEWS

NATIONS AT WAR: WHY DO NATIONS PARTICIPATE IN WAR AND WHY NOT?
- a report on the participation of National Defence University representatives at the International Scientific Conference in Sofia, organised by the Euro-Atlantic Conflict Studies Working Group within the framework of the Partnership for Peace Consortium of Defence Academies and Security Studies Institutes

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On May 28-30, 2013, the representatives of the National Defence University (NDU) in Poland - Col. Assoc. Prof Dariusz Kozerawski (the vice-rector for military and international cooperation) and Assoc. Prof Janusz Zuziak, took part in the 13th Annual Conference of the Euro-Atlantic Conflict Studies Working Group on *Nations at War: Why Do Nations Participate in War and Why Not?,* organised by the G.S. Rakowski National Defence Academy and the French Defence History Office under the auspices of the PfP Consortium of Defence Academies and Security Studies Institutes in Sofia, Bulgaria.

The main objectives of the conference were to exchange scientific views and experiences on, among other things, military history, the study of armed conflicts, and military thought on the conference subject in relation to the concept of the use of modern armed forces. On these grounds, the conference was addressed mainly to researchers dealing with the recent history of military and international security.

On May 28, 2013, after the official opening of the conference and welcoming of the participants, including the representatives of the organising countries (Bulgaria and France) – Theodore Tagarev (Minister of Bulgaria's National Defence), General Oliver Paulus (Director of the French Defence History Office MoD), Cmdr. Dimitr Angelov (the Commandant of G.S. Rakowski National Defence Academy in Sofia), the schedule of the conference was presented.

Due to the international nature of the conference and the language (English) in which the speeches were prepared, the discussions were held within consecutive plenary sessions. To reduce the costs, the organisers decided to resign from the use of simultaneous translators. The participants were accommodated in two hotels (the Crystal Palace and a military hotel: Shipka).

During the seven scientific sessions of the conference, 20 lectures, whose parts were enriched with multimedia presentations, were delivered. After each session led by a moderator, the authors of the speeches took part in discussions and answered numerous questions from the participants. It should be emphasised that dozens of scientists from 15 countries (Austria, Bulgaria, the Czech Republic, France, Greece, Canada, Germany, Poland, Serbia, Slovakia, Slovenia, the USA, Sweden, Romania, and Hungary) took part in the conference, organised under the auspices of, and in cooperation with, the Euro-Atlantic Consortium of Defence Academies and Security Studies Institutes for Armed Conflicts Studies operating with NATO. In most cases, they represented historic military institutes, but also strategic research/studies institutes, which have significant scientific potential for research on the history of the armed forces of particular countries and their national security issues (it should be noted that in Poland there is no such institute in the structures of the Ministry of National Defence).

Poland was represented at the conference by the researchers of the National Defence University. The NDU representative - Col. Assoc. Prof. Dariusz Kozerawski, the vice-rector for military and international cooperation, gave a speech during the sixth panel on *Multinationality as a Strategic Challenge for Coalition Operations: a Case Study of Polish Military Contingent Experience from Iraq (2003-2008).* The talk, enriched with a multimedia presentation, was based, among other things, on the results of field research conducted by the author in the Republic of Iraq in 2008. The speech given was of great interest to the participants, which was confirmed in a lively discussion with the NDU representative.

Moreover, during the above event, the participants were given a publication, which was the result of the work of the previous conference on *Past through Present: Thoughts on Military History at the Strategic, Operational and Tactical Levels of War* which took place in Vienna in 2012 and was organised by the Austrian Museum of Military History and the Hungarian Military History Institute. In this prestigious, collective scientific study the following articles were published in print:

– Col. Assoc. Prof. Dariusz Kozerawski - *Theory Against Realism – the Use of the Soviet Strategy and the Antiterrorism Coalition Strategy in the Wars in Afghanistan (1979-2012)*
– Assoc. Prof Janusz Zuziak - *The Polish Military Effort during the Second World War.*

It is worth mentioning that the historical and scientific trip organised on the second day of the conference (May 29) was very interesting in the cognitive sense. The participants visited: the Thracian fortress in the town of Starosel (V-III century BC), the Archaeological Museum and the excavations of the ancient town of Hissar.

Another event of this kind will be organised next year by Slovakia in Bratislava and its co-organiser, as in previous cases, will be the Euro-Atlantic Consortium of Defence Academies and Security Studies Institutes for Armed Conflicts Studies operating with NATO. The suggested theme for the conference next year will cover the issue of the role of policy and diplomacy in wars and military conflicts.

It should be emphasised that the goal of the trip was fully achieved. The giving of a speech by a representative of NDU, in such a wide and influential, international, and scientific environment, made it possible to confirm the image of the university as one of the major centres conducting research in the field of military history and international security. What is more, the significant position of NDU in the Consortium mentioned above was confirmed with the invitation for the NDU representative by the representatives of Bulgaria and Greece to carry out a series of classes at universities and military schools in these countries.