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## MODERN TECHNOLOGIES AND THE MODERNIZATION OF THE POLISH ARMED FORCES

**Abstract.** The article presents the systemic solutions in the area of the process of acquiring military equipment adopted by the sector of national defence. A constructive criticism of certain elements of these solutions is presented as a result of the activities of the Inspectorate for the Implementation of Innovative Defence Technologies (I3TO). The article discusses the issues concerning the organizational model developed by I3TO and the set of tools used by the staff of the Inspectorate.

The I3TO's opinions on the role of technology, including key and breakthrough technologies in the weapon system, links and relationships between actors involved in the development of new solutions, form also a background to indicate the role and achievements of the Inspectorate in identifying interesting technical solutions from the defence point of view, initiating research projects and implementing the results into practical solutions in military equipment.

The role of the adopted classification of technology readiness levels (PGT) is shown. Issues related to the management of intellectual property rights have also been pointed out. In conclusion, reference is made to the need to develop a consistent model of the system for the acquisition and use of military equipment applicable throughout the sector of national defence.

**Keywords:** modernization of armed forces, military equipment, equipment acquisition, Inspectorate for the Implementation of Innovative Defence Technologies, I3TO, breakthrough technologies, technology readiness levels, PGT.

### 1. INTRODUCTION

Since the dawn of armed conflicts strong army decided about achieving political objectives. The consolidation of this situation became even more apparent after the entry into the general circulation of the art of war theory of the phrasing of the Prussian armed combat theorist Carl von Clausewitz that "war is the continuation of politics", which has made the political factor to be even more focused on the condition of its own armed forces. Hence, many states seek to maintain the army's combat potential at the appropriate level, ensuring to have a potential advantage over the opponent at the outset. In general terms of the theory of the art of war, superiority is viewed in qualitative and quantitative terms. Transformations in the methods of conducting combat and gradual departure from the model of mass army have resulted in departing from the quantitative aspects, and the emphasis is transferred to the realm of quality. Thus the question arises: *what really is the strength of the army?*

The theory of the art of war comes to help here, where those combat factors are endorsed which affect the potential result of armed conflict, or at least their assessment allows for an estimate of the probability to achieve the desired goal of action. These factors include: *damage infliction, information and area. Damage infliction* is described by many elements,

one of the most important of which is the used military technology, which translates into the effectiveness and potential of the armed forces. It is difficult to assess how important, in the general description of the potential capabilities of the armed forces, is the element of quality of the used weaponry, but all armies aspire to possess state-of-the-art military equipment, the parameters of which enable achieving battle objectives, while maintaining the cost-effectiveness of the actions taken.

Evaluation of the combat potential of military units, or of the armed forces in general, are based on adopted sets of parameters, and military technology is described using tactical and technical data. Comparison of these parameters with respect to the opponent helps in the rough estimation of the possibilities and methods of conducting actions. Operational assessments take account of the conversion factors which allow comparisons of weapons at different levels of technological advancement.

## **2. TECHNICAL MODERNIZATION OF THE ARMED FORCES**

The significance of the technical factor in contemporary and future combat operations remains one of the most important elements determining their efficiency and effectiveness. The pursuit of armed forces to possess the most advanced weapons, which warrants an advantage over a potential enemy, translates into the dynamics of the development of science and of the defence industry, which deliver adequate tools for conducting combat activities. The key in providing the armed forces with military equipment of the highest quality is the close link between research institutions, which develop modern technologies, and industrial entities which implement these solutions into armament.

Improving the capabilities of armed forces through a permanent, planned and organized replacement of armaments for new weapon systems having improved tactical and technical parameters is common in all armies of the world. It is also a lengthy, complex and costly process, in which many entities specializing in the execution of tasks at different phases or stages of the life cycle of military equipment are involved.

Under Polish conditions, the saturation of the armed forces with modern equipment takes place through the implementation of three options:

- 1) purchase - the most obvious path to meet operational needs, where the main factor is the available funding;
- 2) modernization - an option requiring adequate industrial resources, focusing on improving the tactical and technical parameters of current armaments;
- 3) research and development - the most lengthy process, requiring the involvement of appropriate research and manufacturing facilities; however, this option warrants the creation of a completely new product, usually one that will be competitive on the world market and having unique specifications.

Rearming of the Polish Armed Forces is effected through the implementation of tasks of all three options. However, there is a different distribution of accents on each of them. The lattermost path of ensuring combat capabilities for the armed forces is the least popular. This

opinion is reflected not only in the list of examples of weapon systems implementation resulting from R&D work, but also the percentage of budget expenditures of the Ministry of National Defence allocated to research and development in the context of funds planned for direct purchases.

### **3. INSPECTORATE FOR THE IMPLEMENTATION OF INNOVATIVE DEFENCE TECHNOLOGIES (I3TO)**

Until recently, in Poland only one organizational unit in the Ministry of National Defence was responsible for carrying out tasks in all three options: the Armaments Inspectorate. The situation changed formally in September 2013, and practically in mid-2014, when the Inspectorate for the Implementation of Innovative Defence Technologies (I3TO) began operating. It was I3TO which took over the leading role in ensuring combat capabilities for the Polish Armed Forces through the implementation of research and development projects, becoming at the same time an active participant in the process of planning the development of armed forces. The Inspectorate executes its tasks in three main areas: research and development, technology related to the use of space for military purposes and the management of intellectual property rights. The Inspectorate for the Implementation of Innovative Defence Technologies, under the provisions of Decision No. 59/MON of the Minister of National Defence of 26 February 2014, has become the main entity for supervising research and development projects in the field of security and defence conducted at the National Centre for Research and Development. The next step is to expand the I3TO's competencies by taking over the coordination of all planning and conducting of the R&D process in the area of engineering and technology, with competencies ranging from the initiation of R&D topics, through selecting contractors and supervising the project, to practical application of the attained results. Therefore, starting from 2018, the Inspectorate will be a fully independent entity supervising the entire cycle from concept to implementation. In addition, some draft decisions of the Minister of National Defence are at the last stage of intra-departmental arrangements. These decisions will make the Inspectorate responsible for the issues of intellectual property rights and technical improvement in the Polish Armed Forces.

I3TO has embarked on an ambitious mission of seeking and implementing unique technical solutions in the armament, innovative solutions that allow for a significant technological advance. The guidelines for the activities undertaken are set out in the ministerial documents of strategic and operational dimension, i.e.: *Operations Strategy of the Ministry of Defence on Defence Research and Technology* and *Priority Research Areas in the national defence sector for the years 2013-2022*. However, the most important reference is the definition of operational requirements developed by the General Staff of the Polish Armed Forces (SGWP). Essentially, the need to meet operational requirements determines the proposed topics for research projects, although not all projects are directly related to operational requirements. Some of them are focused on seeking new solutions in the area of the so-called breakthrough technologies. An example of that may be the material technologies or photovoltaic technologies.

Successful identification of breakthrough technology, positive verification of its availability and practical application, coupled with rapid deployment of production and entering into service can bring the much desired qualitative advantage. The described path is an exemplification of the ideal model, which brings multiple benefits due to obtaining unique capabilities. However, it must be borne in mind that in the process there is a high level of risk attributed to undertaking such challenges and involving significant human and financial resources. Unfortunately, in this regard, we still have to break the established attitudes of focusing on solutions that are certain, but do not significantly improve comparison with the systems of the potential enemy. There is a complete lack of tools for risk assessment at each stage of the decision-making process related to undertaking breakthrough technology research.

### **3.1. Technology readiness levels (PGT)**

One of the ways to reduce the risk of failure in the selection of the area and subject matter of research, adopted by the Inspectorate employees, is the use of a nine-stage classification of technology readiness. On the first level I3TO specialists build knowledge of the progress and research achievements in specific areas of interest. For this purpose, I3TO has developed and implemented a database of innovative defence technologies for use in the National Defence sector, where data is collected about entities and technical solutions both in Poland and abroad. This repository of innovative technologies is used by soldiers actively involved in the programming of the capabilities of the Polish Armed Forces who work for the units of the General Staff and for operational level commandos. The Inspectorate's valuable experience is that of promoting relations between the research institutions and the industry. In many institutions, security and defence centres have emerged which, in addition to fulfilling communicating functions, also help in selecting, processing and systematizing information. Continuous collaboration is not only about scientific ventures, but, above all, on the directions and areas of interest of the armed forces, as well as tracking of research competencies of institutions in the indicated areas of technology. Joint activities allow to identify engineering and technological solutions that are already at a certain level of advancement. In principle, we focus on project proposals that already represent the capabilities of technology readiness level (PGT) III or IV <sup>1</sup>.

The second stage is the requirement that the potential contractor undertakes to develop a technology demonstrator. This is the stage of the study, classified as VI PGT, at the end of which it is possible to assess achievements in terms of availability and usability. At the moment, breakthrough technology can be advanced as one of the means to provide for the needs of the armed forces and be formally incorporated into operational requirements.

Another element of risk reduction is the adoption of the principle of achieving in a given project level IX PGT, i.e. obtaining a real declaration that the solution will be implementable. Through preparatory work for the research process, the Inspectorate receives

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<sup>1</sup> Classification according to the annex to the Ordinance of the Minister of Science and Higher Education of 4 January 2011 on the management by the National Centre for Research and Development of research or development works for the State defence and security.

the approval of the organizer of the functional system and of the potential future users of the product that incorporates the implemented innovative solution. It should be emphasized that the effectiveness of such an approach requires the addition of an industrial element to the group of researchers, shortening thereby the time needed to prepare the manufacturing process.

The experience of the current activity of the Inspectorate indicates that the most important step in the process of searching for innovative solutions is to reach level VI PGT and verify the developed technology demonstrator. Specifying this level in the research process is also of formal significance. Research projects aimed at exploring the availability of new technology solutions do not have to meet the strict requirements for military equipment acquisition system. The passage of research and development above this level necessitates the greatest possible correlation of achieved results with the procedures set out in *Decision No. 141/MON of the Minister of National Defence of July 5, 2017 on the system of acquiring, operating and withdrawing military equipment of the Polish Armed Forces*. Noticeable shortcoming of the current procedures applied by the Ministry of National Defence in the area of acquiring weapons is the lack of a strong linkage between the undertaken research and development projects, which are intended to be completed at the level of a prototype, with practical implementation of solutions in the armed forces.

### **3.2. Long-term research plan**

The subjects of research projects identified by I3TO, after passing the assessment cycle, are introduced into the long-term research plan in the sector of defence. This means that the submitted projects are of interest to the armed forces and that funds are guaranteed to finance them. There are two possible modes of launching projects:

- 1) as a project implemented within the statutory framework of the National Centre for Research and Development (NCBiR) - in this case it is included in the group of security and defence projects;
- 2) as a project executed in the defence sector - in this case, the whole procedure of selecting the contractor is based on the provisions following from the directives of the Ministry of National Defence.

In both cases, open projects are closely monitored by designated staff of the Ministry of National Defence, who form supervisory teams. The main task of MOD experts is to assess progress and compliance with expectations.

On this occasion we touch another problem area, inherent in the process of building the operational capabilities of the armed forces using home-developed technologies. It is the decision of the State to protect selected, breakthrough or innovative technologies. Giving special importance to selected technologies allows for prolonging the time of the solution's competitiveness and thus maintaining a qualitative advantage in this regard. In addition, it prevents its leaking to external and unfriendly markets, and creates conditions for continuous development in a specific technical field and building a leading position. Solutions that

restrict technology transfer to external markets are known and are applied by many countries, and the mechanisms used are different. However, the decision to limit the availability of indicated technological solutions brings about certain consequences, above all of a systemic nature, financial and organizational. Making a "blockade" for a technology forces the state to declare the technology areas of interest, which should additionally result in locating these technological solutions in the products of the domestic defence industry. Inevitably, such entities and products should be actively supported by the government and by the armed forces, ensuring thereby not only domestic sales, but also strong support abroad.

Such activities should be supported by the stable grounds of the state armaments policy expressed in the documents of strategic and operational importance. The efficiency and effectiveness of actions aimed at ensuring long-term potential of the Polish Armed Forces will depend on the adoption of clear and transparent division of competencies and responsibilities and on the establishment of a hierarchy among all actors involved in the development of the defence potential. Only coordinated and interrelated processes, which take place in the various areas of responsibility, combined with the unity of the objective, which is the Armed Forces capable of accomplishing the tasks entrusted to them, will bring about the expected synergy effect. This is the approach taken by the team of the Ministry of National Defence (in which the I3TO representatives are actively involved) working on the development of the National Armaments Policy.

#### **4. BREAKTHROUGH TECHNOLOGIES**

The activities of the Inspectorate for the Implementation of Innovative Defence Technologies in search of breakthrough technological solutions are not focused solely on institutional entities. In addition to building and consolidating solid information links with research centres and defence industry development units, I3TO is open to ideas coming from individual innovators and inventors. Every proposed idea (research concept) undergoes the same path of assessment as the projects submitted by research and industrial teams, and when approved, the optimum mode of conducting further research and development is sought. In recognition of the efforts of individuals and institutions to seek unconventional and innovative solutions in the area of defence, every year I3TO organizes an "Innovation Gala", which is the culmination of a competition run under the patronage of the Minister of National Defence. Three such events have already taken place, where 30 inventors have been honoured in three categories: industry, science and individual creators. In the first edition of the competition, conducted by a Chapter composed of military specialists and scientists, 33 projects were submitted. One year later the number of submitted projects increased by 100% and 66 proposals have finally qualified. This year the number of projects exceeded our expectations and amounted to 164. This shows the great latent inventive potential in our country, which has not always been recognized and properly supported.

Identifying innovative engineering and technological solutions alone does not bring about any effect. It is necessary to be able to verify the solution, combined with the premise of its direct practical application. Time spent on the subsequent stages of the process plays the key role. Any delay or lack of decision significantly reduces the competitiveness of the

solution and the chance of creating a unique product. Pressure of time concerns not only the lengthy and inert administrative process, which is not conducive to the immediate commencement of research, but also the sluggish process of the development work itself. It is clear that one factor that impedes the pace of decision making and the scale of work is the availability of funds. In the case of breakthrough technologies, for instance in the field of electronics, postponing the decision to launch a project to the next financial year sometimes even stops the process of formulating premises because of the necessity to continually update them. One possible organizational solution that can speed up the process is to provide a reserve for launching research into priority defence technologies and to channel and limit responsibility to one executing entity that could naturally be the Inspectorate for Implementation of Innovative Defence Technologies.

## **5. INTELLECTUAL PROPERTY RIGHTS MANAGEMENT**

Protecting intellectual property is a separate area of interest for I3TO, which has a strong effect on the ability to generate and conduct research and development, and further translates into the ability to implement weapon solutions. Experience with projects supervised by the Inspectorate indicates the need to organize and consolidate these issues by way of legal arrangements that would be accepted by the Ministry of National Defence and guarantee transparency, consistency and permanence of the rules in this regard. In projects carried out by NCBR the statutory holder of inventions, utility models and industrial designs, on behalf of the State Treasury, is the Minister of National Defence. As a result, the project creators have the impression of irrevocable loss of industrial property rights and the inability to expand ideas during future research. The work undertaken by I3TO seeks to comprehensively regulate both industrial property rights and copyright in such manner that regulations do not deprive the researchers and inventors of their right to use the products of their activities, while fully protecting the interests of the State Treasury and the needs of the Ministry of National Defence and of the Polish Armed Forces.

## **6. FURTHER WORK**

Establishment of I3TO in September 2013 was an act indicating the forward-looking vision of fulfilling the needs of the armed forces and complementing the developed armaments acquisition system with an R&D-focused entity. This way the armaments divisions of the Ministry of National Defence, along with the units of General Staff, is fully capable of creating a coherent policy of improving the capabilities of the Polish Armed Forces based on national scientific and industrial competencies throughout the life cycle of a defence product. However, the formal representation of organizational and institutional solutions has some shortcomings which require corrective action. It would be helpful to work out a coherent model of the system of acquisition and use of military equipment, such system being a part of the process of planning and programming the development of the armed forces.

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