

3.3. Innovative and military-industrial component of overcoming modern challenges of the Baltic-Black Sea region countries

The importance of innovation impact in the world economy is gradually increasing. The intensification of scientific and technological progress and trends inherent in the present stage of economic development suggest that the type of innovation will be decisive, with the economy, in turn, becoming more innovative.

At the same time, the current global geopolitical situation is characterized by instability and the level of security decreasing in many regions. This can be attributed to a number of reasons.

Reducing the role of the United Nations Organization, focusing on solving internal problems of United States of America, the impending conflict between the United States and China, the growing ambitions of the Russian Federation, etc. Central and Eastern Europe is one of those regions in which this tension is felt most acutely.

Today it is expressed in a military conflict in the east of our country. The high probability of this conflict occurrence was predicted by some politicians and scientists in the field of geopolitics and international relations in the late 90s, among which the most prominent example is Zbigniew Brzezinski (Brzezinski, Z. (2016)). He also predicted that in the event of Ukraine's reintegration, in one form or another, into Russia, Poland and other Eastern European countries would be at the forefront of the confrontation between Russia and the Western world.

In this regard, it is important to understand development speed of scientific and technological progress as well as the scientific tools that allows to effectively manage and predict the trends of its development.

It is important to understand the approaches that allows to analyze and take into account economic, political and innovative factors of development. In order to effectively use them at the state level, thus ensuring its own security function.

The tendency to prioritize national economic interests over regional security interests also contributes to reducing security in Central and Eastern Europe. It is now just over ten years since the publication of Chesbrough's (2003) recognized seminal work, introducing the concept of open innovation in management studies innovation.

The concept, originally aimed at managerial audience level, has attracted considerable interest among researchers in the field of innovation studies, and policy-makers.

For practitioners, it was viewed as a means of spanning the boundaries of control in the creation and commercialization of innovation beyond the enterprise (West et al, 2014).

For researchers, it launched the signal for the advance of a 'new paradigm', leading to a profusion of numerous books, journal articles and conferences (for details about the expansion of this body of literature please refer to "Chesbrough and Bogers, 2014").

Ultimately, this could be viewed as the emergence of a distinct academic community. Acknowledging the developmental potential of the approach, policy makers regionally, nationally and transnationally figured out how to re-align their actions towards open innovation.

The basic premise of this new approach is to open up the innovation process (Huizing, 2011). One of the most commonly used conceptualizations defines open innovation as "the use of on purpose inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation respectively" (Chesbrough, 2006).

For analytical convenience purpose, rather than an accurate reflection of a preceding empirical reality, it comes in contrast with closed innovation, where enterprises internalize the whole process (from generating ideas to commercial exploitation).

Whilst open innovation may be explored at different levels, research to date has recently tended to focus more attention directed at teams and projects, at firm's level (West et al, 2014).

Given the above trends, it is advisable for Central and Eastern European countries to integrate their military, industrial and innovation potentials to enhance the security of the Baltic-Black Sea region and increase their competitiveness in the global race for resources context.

Analysis of existing achievements and publications. Note that considering open innovations, it is important to study the dynamics of its development. Comparing with Chesbrough's (Chesbrough, 2006) closed innovations, where he cites various examples of closed innovation industries: nuclear reactors, mainframe computers, aircraft engines.

Today's trend is characterized by agile changes and fierce competition, where relying on standard solutions is no longer necessary.

Then the principles of open innovation become particularly relevant, (Chesbrough, 2006):

- not enough smart people work for us: we need to work with smart people inside and outside our company;
- external R&D create significant value, internal R&D is needed to claim some fraction of that value;
- building a better business model is better than going to market first;
- if we make the best use of internal and external ideas, we will win;
- we should profit from other's use of our IP, and we should buy others' IP when ever it advances our own business model.

The importance of the institutional context in facilitating access to firm's external knowledge resources, thus enabling innovation, is particularly relevant in the case of post-socialist countries.

In the late 1980s and early 1990s, they embarked on a process of large-scale discontinuous change: away from long-established institutions governing planned economies towards the introduction of new market.

This is because it may be relatively easy transitional economies to 'copy' the formal institutions of a market economy.

But it is much more challenging and time-consuming to get the corresponding informal institutions working as well as realize the behavior change among stakeholders.

The scope of our study is the Baltic-Black Sea region countries.

A significant number of publications, most of which journalistic sources, are devoted to the cooperation of the Baltic-Black Sea region.

Nevertheless, there are a significant number of scientific publications in this area, among which coexist both articles and monographs-(Tkachenko, 2016, Levy, 2007, Chodakiewicz, 2012 etc.).

However, all of them are devoted to the historical, political, social, cultural and other humanitarian aspects of cooperation.

In the modern world, the above-mentioned aspects of the development of countries and regions can be achieved only if they are made on the basis of a powerful post-industrial economy, competitive science, innovation potential and a high-tech army.

Acknowledging the development potential of the approach, policy makers regionally, nationally and transnationally figured out how to re-align actions driven towards open innovation.

During the analytical review of existing publications, many sources were identified that dealt with the production of weapons and military equipment, national armies equipment, the issues of import and export (Ukrainian Military Pages, Analysis modernization & development of Polish Army in 2017 etc.).

However, all of them only consider economies taken separately and use only descriptive statistics without using modern data analysis methods. Stockholm International Peace Research Institute offers a huge number of analytical reports on security issues in the world, modern military conflicts, armies equipment, weapon transfer and military equipment (Martin, Milan, 2016, Wezeman, 2018 and etc.).

The nature of most of the reports are global and rely only upon descriptive statistics and comparative analysis. Of particular relevance is the information support on-emerging processes.

Thus, patent information is used at all stages of the life cycle of technology objects. With their use, the development of technical innovations and their patenting carried out, prospects for commercialization of the created industrial property objects and their competitiveness are determined, promotion of new equipment issues on the market are being addressed.

Basic research materials. Consider the mutual supply of weapons and military equipment between the countries of the Baltic-Black Sea region (Ukraine, Poland, Hungary, the Czech Republic, Slovakia, Belarus, Lithuania, Latvia, Estonia, Romania, Moldova, Bulgaria, Azerbaijan and Georgia) for 2014-2017, compiled database by Stockholm International Peace Research Institute (SIPRI Arms Transfers Database, 2017).

Based on this analysis, the following trends can be highlighted:

- trade in armaments and military equipment between the countries of the Baltic-Black Sea region is mainly offset by the transfer of used and modernized models;
- Ukraine occupies a dominant position in the arms and military equipment market in the Baltic-Black Sea region, with Ukrainian arms exports to the countries of this region being roughly equal to all the other countries above, combined;
- further to the outbreak of armed conflict in the east of the country, exports of Ukrainian weapons and military equipment fell sharply, but imports from the Baltic-Black Sea countries grew only slightly and are characterized only by the order of Warmate unmanned aerial vehicles from the Polish company WB Group;
- regularity, long ago observed by scientists and politicians, about the upcoming military conflict is evidenced by a sharp increase in the country's weapons costs characteristic of the Baltic-Black Sea region, as Georgia sharply increased the import of weapons and military equipment from Ukraine, Poland and Azerbaijan in 2007;
- in 2017, imports of armaments by Azerbaidjan increased, which, in the presence of a frozen conflict in Nagorno-Karabakh, is an alarming trend.

Within the scope of this article we will not address the military-political sides of cooperation between the countries of the Baltic-Black Sea region, but concentrate on the innovation-technological as well as organizational & economic aspects of such cooperation.

We will analyze the possibilities of such cooperation on the basis of the industrial defense and innovation potential of Ukraine and Poland, as the largest exporters of weapons and military equipment among the countries of the region (Wezeman, 2018).

An overview of the products and services of the State Concern "Ukroboronprom" and the Polish Armaments Group, an association of arms manufacturers and military Poland, is available on the website of these organizations.

Competitive directions of possible cooperation of these enterprises are diverse and deserve separate publications. As part of this work, we will focus on a quantitative assessment of the impact of increasing in the usage of weapons and military equipment in the domestic markets of Ukraine and Poland on their exports from these countries.

We will conduct a quantitative assessment using statistical data sets submitted by the Stockholm International Peace Research Institute (Military expenditure by country as a percentage of GDP – Gross Domestic Product, 2018).

Table 1 shows the financial indicators of arms exports (\$ million, year 2016) and military spendings as a percentage of GDP for Ukraine and Poland for 2005-2016 (Military expenditure by country as percentage of gross domestic product, 1988-2002, 2018, Government and industry data on the financial value of national arms exports, 2001-2016, 2018).

Table 1. Arms exports and military expenditures for Ukraine and Poland, 2005-2016.

Year	Ukraine		Poland	
	The financial value of arms exports, in \$ constant (2016) US\$	Military expenditure by country as percentage of GDP – Gross Domestic Product	The financial value of arms exports, in constant (2016) US\$	Military expenditure by country as percentage of GDP – Gross Domestic Product
2005	731	2,6	443	1,9
2006	731	2,7	411	1,9
2007	810	2,8	455	2,0
2008	892	2,6	601	1,8
2009	895	2,8	2162	1,8
2010	1053	2,7	666	1,8
2011	1071	2,3	1259	1,8
2012	1070	2,4	850	1,8
2013	1030	2,4	1174	1,8
2014	804	3,0	1237	1,9
2015	577	4,0	1425	2,1
2016	770	3,7	1357	2,0

Paired linear correlation coefficient between the financial value of arms exports and military expenditure by country as percentage of GDP – gross domestic product for Ukraine is – 0,745, and for Poland is – 0,007. Moreover, the correlation coefficient for Ukraine is statistically significant by Student's criterion with a probability of 95%.

So, a linear relationship between the financial value of arms exports and military expenditure by country as percentage of gross domestic product for Ukraine can be described as a strong inverse.

This situation can be explained by the fact that after the outbreak of an armed conflict in the east of the country, and, accordingly, an increase in the defense budget, a significant shift in defense products to the domestic market occurred.

The relationship between the financial evaluation of arms exports and-military expenditure by country as percentage of GDP for Poland missing. This is due to a more stable military-political situation in this country, thanks to participation in the NATO collective security system. The financial value of arms exports and military expenditure by country as percentage of GDP gross domestic product for Ukraine make it reasonable to quantify this linear constraint by the least squares method:

$$\hat{y}_i = 1523,44 - 230,8 \cdot x_i + \varepsilon, \quad (1)$$

where $\hat{y}_i$ – the financial value of arms exports;

x_i – military expenditure by country as percentage of gross domestic product;

ε – random and unaccounted factors in the model;

$\beta_0 = 1523,44$, $\beta_1 = -230,8$ – parameters of regression.

The regression parameters are statistically significant by Student's criterion with a probability of 95%.

The economic meaning of the parameter is the OLS – assessment of the export of Ukrainian weapons and military equipment, if the percentage of GDP spent on defense is zero, i.e. it is estimated in millions of \$. The economic meaning of the parameter is to reduce the financial value of arms exports with increasing military expenditure by country as percentage of GDP on 1%. That

is, for every 1% of the GDP Gross Domestic Product invested in supplying its army with armaments and military equipment, the fall in Ukrainian exports of these products is estimated at 230.8 million \$.

We will bring on Fig. 1 correlation field, which is constructed according to the Table 1 and showing the regression line (1) that describes it.

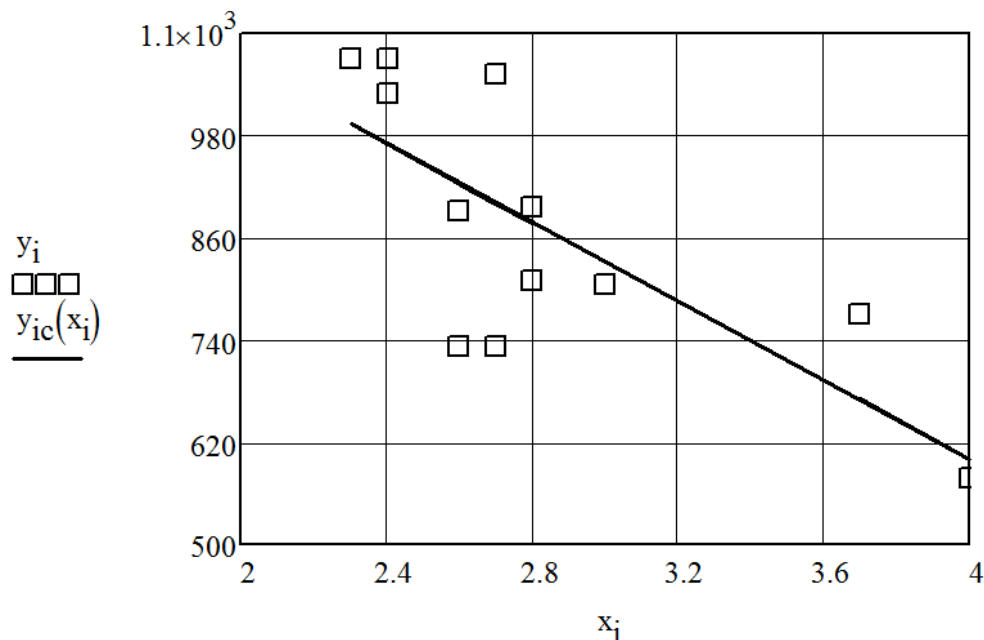


Fig. 1. Dependence of the financial value of arms exports, in constant or Military expenditure by country as percentage of gross domestic product

On Fig. 1 it can be seen how a sharp increase in the percentage of Ukraine's GDP spent on defense has affected the decrease in exports of weapons and military equipment in recent years (the last two sampling points).

Let us evaluate the quality of the model by the coefficient of determination, which is 0.555 and statistically significant by the Fisher criterion with a probability of 95%. This value of the coefficient of determination indicates that the amount of variance of the dependent variable (the financial value of arms exports), the model explained is 55.5%, while 44.5% is accounted for by random factors unaccounted for in the model.

In addition to the usual assumptions and those made in estimating linear links using the least squares method, we assume that the impact of Ukraine's GDP decline on financing the rearmament of security forces was offset by financial support from Allies, including through NATO trust funds.

Currently, many politicians and military experts are talking about the need to bring defense costs level up to 5% of their GDP.

According to the model (1), the estimated point of the predicted value the financial value of arms exports will be \$ 269.45 million.

Conclusions and prospects for further research. The empirical research in Ukraine shows that, against literature-sourced expectations, the adversity of the institutional setting does not constrain enterprises, belonging to the four types of innovation outcome, from accessing to externally generated knowledge.

This is particularly the case regarding innovation implementation, in comparison to the early (generation of ideas) stages in the process.

Innovative enterprises appear to adopt rather diverse strategies regarding the means used to access to externally generated knowledge.

As prospects for further research, it is advisable to supplement model (1) with an additional independent variable characterizing the change in GDP over time and the assistance of foreign allies.

Thus, the organizational and economic mechanism for managing a scientific and technical regional program in an innovative economy should be based on a combination of market actions and state regulation. These actions should be aimed at developing and implementing a long-term perspective for the development of science and technology, and strengthening the defense of the Baltic-Black Sea region.

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