NEW CONDITIONS,
NEW PERSPECTIVES,
NEW CHALLENGES
IN THE NEW GLOBAL ECONOMY
EDITOR’S NOTE

Dear readers,

Dear authors and friends,

This is the second issue of the Scientific Journal KSI Transaction on Knowledge Society for 2015, dedicated to the different aspects of the Economic, Finance Management and International Relations and Geopolitics.

Modern world is a complex, dynamic and rather unpredictable system that we try to unravel in scientific manner any aspects of this. Our developments on current trends and today’s phenomenon may provide us with answers, but also may open new fields for further scientific researches.

One of the most inspirational quotes about science is from Marie Curie – “Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less”.

Every scientific work development presented to the general public in fact contributes to know and understand more, so we can be more adaptive and flexible to the current requirements and challenges.

We, as an International Editorial Board, have an ambitious goal – to provide an opportunity for presentation for every young scientist and also for colleagues with undisputed scientific experience to publish in our magazine on the topics of different aspects of modern world development. We do believe that in global world working together is not another good quote, but also a tool that we can use in order to secure more understanding.

Today we are all witnesses of unprecedented economic, financial and geopolitical events. Unlike other people, we as scientists, we are obliged to explain these phenomena. So, the floor is yours!

Kind regards of all our readers!

International Editorial Board
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Issues of quantitative assessment of the industry structure of a country’s region

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Abstract. The competitiveness of a country’s region is significantly influenced by the structure of the industrial companies operating therein. Review of literature on the issue revealed that the majority of research is focused on a thorough assessment of changes to the said structure. It is an attempt to identify branches of industry the results of which are best for other branches. In other instances it is assessed with respect to exports of the branches, still in other instances the focus is on the economic results of the branches of industry. This allows us to conclude that today there are no methods for the complex quantitative assessment of the industry structure of a country’s region. The purpose of this paper is to reveal issues of quantitative assessment of the industry structure of a country’s region.

Keywords: competitiveness of a country’s region, industry structure of a region, methods of assessment.

JEL: R10, O10, L60.

I. INTRODUCTION

Recently there have been more attempts to analyse the different aspects of regional development: what are the objectives of regional development, what should the strategic planning of regional development look like, what ensures sustainable development, etc. The practical realization of all these aspects of regional development is related to the competitiveness of regions understood as the ability to create favourable conditions for the development of economic activities, satisfaction of the needs of residents (A Study on the Factors of Regional Competitiveness, 2003; Mas-Verdu, Soriano, & Dobon, 2009; Tetsu, 2006; Skyt-Larsen, 2015; Boschma, 2004; Budd & Hirmis, 2004; Simanavičienė, Bruneckienė, & Šimberová, 2007; Rutkauskas, 2008; Snieška, Čičiūkaitė, Neverauskas, & Clusters, 2002; Bruneckienė & Čičiūkaitė, 2009; Lall, 2001; Huggins, 2003; Fridman, Rechko, & Pimonov, 2012; Berger & Bristow, 2008; Banytė & Saliečiauskaitė, 2008; Glimskienė, Daraškevičiūtė, & Lipinskienė, 2006; Annoni & Dijkstra, 2013; Wokoun, Damborský, Kourilová, & Krejčová, 2012). In the global context, competitiveness becomes the essential condition for development and even survival. Market growth is the result of regional development as well as the general economic development of a country. Competitiveness transforms into the object of functioning from a condition to functioning, the object of regional development (Žitkus & Mickevičienė, 2013).

Literature analysing regional competitiveness stresses the significant influence of the competitiveness of companies operating in a region (Gardiner, Martin, & Tyler, 2004; Grebliauskas & Stonys, 2012; Ženka, Novotny., & Csank, 2012; Aiginger, 2006; Camagni & Capello, 2013; Tamošiūnienė & Štaskevičiūtė, 2011; Rakauskienė & Tamošiūnienė, 2013; Nicholson, Tsagdis, & Brennan, 2013; Charles & Zegarra, 2014; Bottazzi, Coad, Jacoby, & Secchi, 2011; Schott, 2004). Not surprisingly the shares of import and export of branches of industry are suggested as the main criterion for the assessment of the industry structure of a country or region.

Then as such competitiveness is viewed as the object of regional development, industry plays an important role. In turn the efficiency of activities depends greatly on the structure of companies operating in the region. Therefore we face both a theoretical and practical problem – the assessment of the structure of a region’s industry, as only the ability to conduct a quantitative analysis allows the analysis of its changes, their effect on the results of activities, and to determine the direction of further development of the structure, i.e. to purposefully manage this process in order to increase the efficiency of activities.

II. AVAILABLE METHODS OF ASSESSMENT OF INDUSTRY STRUCTURE

Both theoretical sources and real life practice confirm that the economic growth of a country and the level of welfare largely depend on the results of industrial development. This may be the reason why the analysis often focuses on the position of industries in a country or a region. Various aspects of the said position are analysed. One of those important aspects is the structure of an industry of a country or region. It is thought that the results of such analysis helps to identify those branches of industry the achievements of which are best compared to other branches. The identification of significant branches of industry allows the potential of its structure to be assessed. A more detailed analysis of the activities and development of the identified significant branches of industry allows the determination of whether the current industry structure is focused on those activities that would be in demand not only within the country but also externally (Saboniene, 2010). Such analysis also helps to formulate an advisable

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economic policy of a country – respectively transforming the structure of an economy and the industry structure.

In order to suggest scientifically-based methods for the quantitative assessment of the industry structure of a region, one has to review the available suggestions. Setting the objectives of analysis of the industry structure is important in solving the analysed issue. The objectives are various: to determine the activities on which the industry of a country (region) is focused; to determine which branches of industry are competitive under the conditions of economic integration; to determine the potential of an industry; and to determine the reasons for structural changes, etc. (Janissen, Thomson, Clark, & Geer, 1998; Brummer & Cali, 2006; Capasso et al. 2015; Szirmai et al. 2005). Some authors strive to define which aspects reflect industry structure (Carlton & Perloff, 1994; Bradbury & Kodryci, 2007).

The listed objectives show that a direct objective in conducting a quantitative assessment of the industry structure of a country or region is not set. Instead it is suggested to either determine the most competitive branches of industry or to assess structural changes. Therefore it is advisable to investigate whether the results of such research reflect the actual structure of an industry.

Some of the research is focused on the identification and analysis of factors of industry structure. It is suggested to divide them all into internal and external environmental factors (Fig. 1).

Some other research is focused on a thorough analysis of changes of the industry structure. It is considered that companies operating in a certain branch are greatly affected by the market. Market changes themselves are caused by the following reasons: changes to the level of concentration of companies and consumers, changes to the conditions of entering and exiting the market, growth of diversification of production, integration and diversification of companies (Carlton & Perloff 1994).

Janissen, Thomson, Clark, & Geer (1998) distinguishes two groups of reasons for structural changes (Sabonienė, 2010):

1. Market-related reasons for structural change:
   - technological changes (e.g. discoveries in the field of microelectronics, IT and telecommunications, new materials, biological technologies, the use of robot technologies, energy technologies);
   - behavioural changes (e.g. changes of income and its distribution, changes in consumption and demand);
   - trade and global specialization (e.g. trade and specialization related to the discovery of new export markets, associated with increased competition arising due to imported production);
   - discovery and consumption of resources (e.g. development of the use of mineral resources, depreciation of land in certain regions due to erosion and salinity of land).

2. Management-related reasons for structural change:
   - liberalization of trade and investment (e.g. one-sided reduced tariffs, non-tariff trade barriers, statutory marketing reforms, multilateral actions to liberalize trade and investment regimes);
   - infrastructural and general country administration reforms (e.g. incentives for privatization of public organizations, incentives for liquidation of regulation of entry barriers, incentives for separation of different segments of infrastructure in order to increase competition);
   - labour market reforms focused on the better use of market mechanisms to define the level and conditions of wages. Reforms of labour market programs, occupational health and safety legislation;
   - competition and other regulatory reforms (e.g. changes to limited trade practices and price management laws, action programs for increasing competition);
   - tax reforms (e.g. improvement of the system of income tax, development of the system of corporate tax).

After analysing the reasons for industry structural change and the change itself, suggestions can be provided for the quantitative assessment thereof. One such suggestion is to determine the level of specialization of the trade of a country or region, i.e. production exported by the branches of industry. This is focused on the shares of export and import of goods of certain sectors of industry (Drysdale, 1988; Garnaut, 1989; Anderson, 1995; Balassa, 1965; Chow & Kellman, 1993; Sheehan, 2000; Bernatonytė & Normandienė, 2009; Sabonienė, 2009; Dumčiūnienė, 2009; Snieška & Brunecienė, 2009; Čučkovic, Jurlin, & Vučković, 2013). A specialization index is calculated that allows to assess the level of specialization of a country in exporting the production of a certain branch (or group of

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![Fig. 1. System of factors affecting industrial structure (Source: Sabonienė, 2010)](image-url)
branches) of industry. It is considered that this index is quite reliable for the analysis of the importance of a specific sector of an economy (Sabonienė, 2009). It is not sufficient for industry structure in the context of a country or region. In order to analyse this as a whole, it is difficult to apply the index (Sabonienė, 2010). As an option it has been suggested to assess the level of specialization firstly in all sectors, and then to combine the assessments as one aggregate value. The integrated index was formed to assess the level of all knowledge applied in the manufacturing of the production exported by the manufacturing industry of the country.

To apply this index, the expenditure of every branch of industry on research and development needs to be known, which is established by OECD. Index CI is calculated according to the following formula (Sheehan & Tikhomirova, 1996):

\[
CI_i = \frac{\sum_{j=1}^{n} (X_{ij} I_{ij})}{\sum_{j=1}^{n} X_{ij} C_{I,0}},
\]

(1)

where \(CI_i\) – specialization index of industry of country \(i\); \(X_{ij}\) – export of branch of industry \(j\) of country \(i\); \(I_{ij}\) – relative ratio of intensity of research and development of branch of industry \(j\) of country \(i\); \(C_{I,0}\) = \(\frac{\sum_{j=1}^{n} n_{ij} I_{ij}}{n_{ie}}\); \(n_{ie}\) – number of manufacturing branches of industry of country \(i\) (\(i = 1, \ldots, n\)).

Thus the index shows to what level the export of goods is concentrated in branches that stress research and development.

Another case: assessment of changes of the structure of industry is based on a single system of indices. Here again the CI index is applied, but it is transformed in a way that allows the income of residents of the country to be assessed, depending on the structure of the industry of the country (Tichomirova, 1997).

Five groups of indices covering the most significant aspects of industry have been suggested (Fig. 2):

- Added value per employee.
- Wages per employee.
- Export growth.
- Export intensity of the branch.
- Index of application of research and development.

The analysis of CI index is based on the assessment of uninterrupted income level that depends on the current structure of the industry. It is also correlated to added value per employee, which is mostly related to the part of added value that can be transferred to an employee in the form of wages as compared to the value received by the owner of capital (Sheehan, 2000).

It is considered that long-term industry structure income potential may be correlated to the rate of growth of the global economy and changes thereto.

The numeric value of the suggested rank covers the overall rank of all components depicted in Fig. 2. Based on this, manufacturing branches are listed in decreasing order according to overall composite rank. In such an instance, industry structure may be assessed based on changes to shares of large sectors of manufacturing industry.

The suggested index is calculated in the following manner (Tichomirova, 1997):

\[
CI_i^T = \frac{\sum_{j=1}^{n} X_{ij} I_{ij}}{\sum_{j=1}^{n} X_{ij}},
\]

(2)

where - the index of the long-term income potential of country \(i\).

Sabonienė (2010) presents the following method for calculating this index:

\[
CI_i^I = \frac{\sum_{j=1}^{n} (X_{ij} I_{ij})}{\sum_{j=1}^{n} X_{ij}},
\]

(3)

where \(CI\) – the Index of the Long Term Income Potential of Industry Structure, \(i\) – a country, \(j\) – the industry, \(n\) – the
total number of manufacturing industries, \( I \) – the value of the overall composite industry rank, \( X \) – exports.

If manufacturing exports were equally divided across industries, then the value of \( X^j \) may be calculated in the following manner:

\[
X^j = \frac{X^i}{n} = \frac{\sum X^j}{n},
\]

where \( X^i \) - total manufacturing exports for country \( i \).

In this case, index \( CI^i \) is the following:

\[
CI^i = \frac{\sum \left[ \frac{\sum X^j}{n} I_j \right]}{\sum X^j} = \frac{\sum X^j \sum I_j}{n \sum X^j} = \frac{\sum I_j}{n} = \overline{CI_T},
\]

where \( CI_T \) - the average value of Income Potential; \( I_T \) – the sum of the values of overall composite industry rank for all manufacturing industries.

The value of \( CI_T \) can be used as a basis for benchmarking the value of the Index of Income Potential:

\[
RCI^i = \frac{CI^i}{CI_T} = \frac{\sum (X^j I_j)}{\left( \sum X^j \right) CI_T},
\]

where \( RCI \) – the Rebased Index of Long Term Income Potential of Industry Structure.

III. SUGGESTED APPROACH TO THE QUANTITATIVE ASSESSMENT OF THE INDUSTRY STRUCTURE OF A COUNTRY (REGION)

The conducted analysis of the available methods for the assessment of industry structure allows us to draw the following conclusions, which are important to the improvement of the methods.

The main conclusion is that though all suggestions maintain that industry structure is analysed, the actual analysis covers not the industry structure itself but rather its changes and effect on the results of activities. And these indices are derivative values of the industry structure.

It is difficult to support statements that the potential of industry structure is reflected by changes to its significant branches and values. First of all, the industry structure reflects all branches.

Changes of industry measured both by the level of specialization and single index systems actually reflect the qualitative aspect of branches of a country’s industry. Especially since the said groups of indices are focused on the income of residents of a country. While the assessment of industry structure is first and foremost a quantitative assessment, it should not cover the resultant, i.e. the derivative indices of activities, but rather the base parameters on which the resultant indices are based.

Currently available industry indices \( C_i \) and \( CI_T^i \) are also essentially derivative values of the industry structure of a country reflecting its competitiveness.

Thus we can conclude that we still lack a method for the complex quantitative assessment of the industry structure of a country or region.

IV. CONCLUSIONS

Recently we have seen more attempts to analyse the different aspects of regional development: what are the objectives of regional development, what should the strategic planning of regional development look like, what ensures sustainable development, etc. The reason being that the competitiveness of a region depends on the practical realization of all these aspects of regional development. Competitiveness transforms into the object of functioning from a condition to functioning, the object of regional development.

Then as competitiveness is viewed as the object of regional development, industry plays an important role. Its efficiency depends greatly on the structure and nature of the economic entities operating in the region. Therefore we face both a theoretical and practical problem – the assessment of the industry structure of a region. Conducting this allows the analysis of its changes, their effect on the results of activities, and to determine the direction for further development of structures, etc.

Various aspects of the industry structure of a country or region are analysed. It is thought that such analysis will help identify those branches of industry the achievements
of which are best in comparison to other branches. The identification of significant branches of industry also allows the potential of its structure to be assessed. The main objectives of such analysis besides the aforementioned are: to determine the activities on which the industry of a country (region) are focused; to determine which branches of industry are competitive under the conditions of economic integration; to determine the potential of industry; to determine the reasons for structural changes, etc.

The listed objectives show that a direct objective to conducting a qualitative assessment of the industry structure of a country or region is not set. The goal is to suggest methods of analysis of structural changes and the quantitative assessment thereof. For this purpose, the specialization index is calculated, which allows assessing the level of specialization of a country (region) in exporting production of a certain branch (group of branches) of industry. In essence, the index shows to what degree the export of goods is concentrated in those branches that stress research and development.

A different assessment of changes of industry structure is based on a single system of indices, which actually reflects not industry structure, but the efficiency of its branches. This is proven by the content of groups of indices: added value per employee; wages per employee; export growth; export intensity of branches of industry; and scope of research and development.

The availability of methods of assessment of industry structure show that the actual analysis covers not the industry structure itself, but rather its changes and effect on the results of activities. And these indices are derivative values of the structure of industry. Changes of industry measured both by the level of specialization and single index systems actually reflect the qualitative aspect of the industry structure of a country, while qualitative assessment of industry structure should be accompanied by quantitative analysis. Therefore we can maintain that we still lack a method for the complex quantitative assessment of the industry structure of a country or region.

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Structural Trends of General Government Expenditure in the Baltic and Scandinavian Countries

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Abstract: This paper has analyzed the patterns of government expenditure in the Baltic countries (Lithuania, Latvia and Estonia), comparing them with those in Scandinavian countries (Denmark, Finland and Sweden). The investigation has summarized the tendencies of structural changes of government expenditure and extent to which countries expenditure structures have been dissimilar in a period of 2004 – 2013. Breakdowns of these expenditures on the basis of the activities they support have been provided and analyzed. The authors have done this by looking both at general government expenditure statistics, and also by considering a number of descriptive statistical indicators. Firstly, based on the statistical data, structural changes of government expenditure have been analyzed. To this end, the indicators of absolute structural changes and intensity of structural changes have been applied. Secondly, Finger-Kreinin index has been calculated in order to compare government expenditure patterns and determine their dissimilarities.

Index Terms: general government expenditure, government expenditure by funcion, economic growth, structural changes, Finger-Kreinin index.

JEL: H50, H75, H76.

I. INTRODUCTION

The investigation has been based on Eurostat information. Eurostat has collected data on government expenditure by function according to Classification of Functions of Government (COFOG). It has provided a possibility to compare expenditures on different activities across the European countries over time. Data are available at two levels. The first level splits spending into ten classes according to functions, and the second level further splits the first level classes into further groups (OECD 2014).

In 2013, general government expenditure amounted to 48.6 percent of EU-28 GDP (Eurostat 2015). Based on the latest available government expenditure data by function for 2013, the important sectors of government spending were social protection, which made 40.2 percent of total general government expenditure, health with 14.8 percent, public services with 14.1 percent and education with 10.3 percent.

Taking into consideration the Baltic and Scandinavian countries, advanced economies differ over the aggregate scope of general government expenditure. In 2013, Finland and Denmark recorded the highest government expenditure share relative to GDP, at 57.8 % and 57.1 % respectively. In Sweden government expenditure made 53.3 % of GDP. In contrast, Estonia recorded the share relative to GDP, at 38.9 %. In Latvia and Lithuania general government expenditure made 36.1 % and 35.5 % of GDP respectively (Eurostat 2015).

The association between government expenditure and economic growth has been a hot issue today and widely debated among scholars and policy-makers. According to Hamzah (2011), in many countries, public taxes have been the main source of government expenditures. The taxpayers have expected that the government effectively allocate their tax contributions. At the same time, the government also hopes to satisfy the public interests and expectations (Hamzah 2011).

The dominant view among economists and policy makers is that the government can play a very important role in the country’s economy. Then economic success is often attributed to the government role (Bataineh 2012). However, the subject of association between government expenditure and economic growth has been still unresolved issue theoretically and empirically as well. In the study, Bataineh (2012) has presented two major theories on economics concerning the relationship between government expenditure and economic growth. Keynesian macroeconomic theory has assumed that increased government expenditure tends to lead to high aggregate demand and rapid economic growth. While Wagnerian theory has presented the opposite view, that an increase in national income causes more government expenditure (Bataineh 2012). A number of recent studies have revealed that many scientists (Arpaia, Turrini 2008; Gomez 2008; Kuehnel, 2009; Pappa 2009; Hall 2009; Abu, Abdulahi 2010; Mehmoood, Sadiq 2010; Taiwo, Abayomi 2011; Ramey 2011; Barro, Charles 2011; Bataineh 2012; Anwar et al. 2012; Patricia, Izuhukuw 2013; Aye et al. 2014) from different countries have focused on this issue. Their researches have suggested different results, such as positive relationship between government expenditure and economic growth, significantly negative relation or no relation.

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This research attempts to provide more reliable estimates of the structural trends in general government expenditure patterns in the Baltic and Scandinavian countries during the period of 2004 – 2013. Scandinavian countries have been selected as advanced economies due to successful economic development, which has been presented by high living standards, social-economic indicators, social conditions and welfare and others. Taking into consideration economic performance of the Scandinavian countries, they could be as a leading objective for the Baltic countries.

The paper is organized as follows. Introduction presents general information about government spending. Section 2 reviews previous studies on the government expenditure and economic development aspects and research methodology. The investigations of different countries are summarized and the main insights are provided. Section 3 provides breakdown and analyses the structural trends in general government expenditure and compares the patterns across the countries observed. Section 4 concludes summarizing the main trends.

II. EMPIRICAL EVIDENCE AND RESEARCH METHODOLOGY

A. The overview of recent studies

The relationship between government expenditure and economic development has been the subject to intense debate among scholars in recent years. Economic theory has suggested that on some occasions lower levels of government expenditure would enhance economic growth while on other occasions higher levels of government expenditure would be more desirable (Alexiou 2009). The researches on government expenditure – economic growth nexus have been done analyzing government expenditure by different activities and economic performance indicators, such as growth, poverty, unemployment, revenue, current account, private activity, consumption and others. Despite a great number of investigations (Pappa 2009; Hall 2009; Atesoglu, 2009; Mehmood, Sadiq 2010; Feridun et al. 2011; Alptekin, Levine 2012; Danek 2013; Dimitraki, Ali 2013; Khalid, Mustapha 2014; Dunne, Tian 2015), the results have been inconclusive. There is no consensus about the existence of relationship between the variables, because of different level of socio-economic development of the countries observed, the period analyzed and methodology applied as well. Hereafter, some results from the recent investigations have been described.

The paper of (Arpaia and Turrini (2008) analyzed both the long and the short-run relationship between government expenditure and potential output in EU countries over the period of 1970-2003. Results have approved the hypothesis of elasticity between government expenditure and potential output close to unity. However, the long-run elasticity has been significantly higher than unity in low-debt countries, fast-ageing countries, and in countries with weak control of government expenditure.

Irmens and Kuehnel (2009) studied and compared the link between productive government activity, economic growth and welfare in different economic settings. The authors have revealed that productive government expenditure impacts on the growth rate of consumption through a direct effect on the technology and an indirect effect on investment incentives through the financing.

The research done in seven transition economies of the South Eastern Europe has generated significant results which may enhance the economic performance of the countries. The results of research have indicated that four out of the five variables, such as government expenditure, on private investment, capital formation, development assistance and trade-openness have had positive and significant impact on economic growth. In contrast, population growth has been found to be statistically insignificant (Alexiou 2009).

Other research has been focused on structural changes of public expenditures in China in the past 30 years. The results have demonstrated an increasing need of the public for education services, housing, social security, and health care. The authors have specified a proper proportion of public spending in total governmental expenditure and discussed possibilities to this structure (Zhu, Wang 2011).

Taiwo and Abayomi (2011) examined the trends and effects of government expenditure on the growth rates of real GDP in Nigeria over 1970-2008. The findings have shown a positive relationship between real GDP and capital expenditure. The authors have recommended that government should promote efficiency in the allocation of development resources.

Batainehe (2012) investigated the impact of public expenditures on economic growth in Jordan for the period of 1990 – 2010. The research has suggested that the government expenditure at the aggregate level has positive impact on the growth of GDP.

The study of Patricia and Izuakwukwu (2013) investigated the impact of public expenditure in education on economic growth in Nigeria over a period of 1977-2012. The results have indicated that a positive relationship exists between the expenditure on education and economic growth in the long run. The authors have concluded that government should direct its expenditure towards the productive sectors like education because it would raise the standard living in the country.

To sum up, the studies have concluded that in many cases the relationship between government expenditure and economic growth has been detected, but the practices of different countries lead to different results. The evidence has suggested that on some cases lower level of government expenditure promotes economic development while on other occasions higher level of government expenditure is more desirable. There is no consensus about the existence of relationship between the variables, because of different level of socio-economic development of the countries observed, the period analyzed and methodology applied as well.

B. Research methodology

This research has been guided by the estimation of
general government expenditure structure in the Baltic and Scandinavian countries. The authors refer to methodology considered in studies of different authors and institutions (Memedovic, Iapadre 2010; Cortuk, Singh 2010; Zhu, Wang 2011; Freysson 2012; OECD 2014; Dudzevičiūtė et al. 2014). The indicators of structural changes (absolute structural change and intensity of structural changes) have been employed. The dissimilarities of general government expenditure patterns across the countries have been analyzed applying Finger-Kreinin index.

The absolute structural changes indicator shows structural change of the pattern analyzed. Positive value means that structural change promotes growth of the pattern; and negative value restricts growth. The absolute structural changes indicator is calculated as follows:

\[ M = D_1 - D_0 \]  

(1)

where: \( M \) - the absolute structural change indicator; \( D_1 \) - activity’s share, \% ; \( D_0 \) - activity’s share, \% in the basic year.

The intensity rate of structural changes shows the shift of the pattern in time \( t_i \) compare with basic period. The higher ratio reveals more intensive structural changes of the pattern analyzed, and conversely. The intensity rate is calculated as follows:

\[ K = \sqrt[2]{\frac{\sum_{i=1}^{n} (S_{0i} - S_{1i})^2}{m}} \]  

(2)

where: \( K \) - the intensity rate of structural changes; \( S_{0i} \) - activity’s share; \( t_i \), \( t_i \) - current and basic time; \( n \) - number of activities; \( m \) - year.

Finger-Kreinin dissimilarity index (D index) measures how much a given distribution differs from a chosen. It is calculated as follows:

\[ D = \frac{1}{2} \sum_{i=1}^{n} |a_i - b_i| \]  

(3)

where: \( a_i \) and \( b_i \) show the share of sector \( i \) in each of the two distributions.

When a given distribution at a given time is compared to the same distribution in a previous period, the D index can be used as a measure of structural change (Memedovic & Iapadre 2010; Dudzevičiūtė 2013).

D index ranges between zero, denoting equality and one, showing maximum dissimilarity.

In general, all these described indicators give general information about economic patterns, but they do not reveal the reasons for the structural changes.

III. THE INVESTIGATION OF GENERAL GOVERNMENT EXPENDITURE TRENDS

A. The tendencies of general government expenditure: detailed analysis by economic functions

In this section, we have investigated the main tendencies of general government expenditure in the Baltic and Scandinavian countries. To this end, firstly, referring to the latest Eurostat data (2015), general tendencies of government expenditure as a percentage of GDP have been presented (Fig. 1). Secondly, detailed analysis of structural changes in government expenditure patterns has been performed (Table 1). Over a period of 2004-2013, general government expenditure as percentage of GDP varied across the countries, as shown in Figure 1.

![Fig. 1. General government expenditure as percentage of GDP](source: Eurostat data 2004-2013)

As a figure above shows, over an analyzed period, the Scandinavian countries have reported greater government expenditure contribution to GDP than the Baltic countries. Advanced economies differ over the scope of general government expenditure. They have devoted around 53 percent of GDP, whereas government expenditure has accounted for around 38 percent of GDP in the Baltic countries.

Making comparison across the Baltic countries, Estonian government expenditure as a percentage of GDP has been greater than in Lithuania and Latvia. Denmark has been the highest spender of Scandinavian countries comparing with the size of economy.

To get the completed picture of general government expenditure across the countries, detailed structural analysis by economic functions has been carried out. Table 1 has revealed the structural shifts in the government expenditure patterns of the Baltic countries.

In the Baltic countries as a whole, government spending on social protection has received the largest share in total general government expenditure. In 2013, social protection spending in total general government expenditure amounted to around 30 percent in Lithuania, Latvia and Estonia as well. The next most important spending has been education amounting to 16 percent in the Baltic countries. Public services (on average 13 percent of total) followed in the Baltic countries in 2013. 2013 compared to 2004, Lithuania has reported the most significant shifts in health, social protection and economic affairs spending by government. The shares of spending on health and social protection have increased by 3.7 and 2.1 percentage points respectively. The contribution of economic affairs has decreased by 2.6 percentage points.
Over the same period of time, Latvia has represented the most important changes in the shares of social protection, public order and safety and education spending as well. The share of the expenditure on social protection has increased by 2.4 percentage points; spending on public order and safety, and education has dropped by 1.5 and 1.4 percentage points respectively.

Estonia has reported the biggest shifts in the shares of education (decrease of 2.9 percentage points) and public order and safety (decrease of 1.5 percentage points).

### Table 1. Government Expenditure and its Structural Changes in the Baltic Countries

<table>
<thead>
<tr>
<th>Country/ General government expenditure by function</th>
<th>2004</th>
<th>2013</th>
<th>Absolute structural change, percentage points</th>
<th>Intensity of structural change, percentage points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lithuania</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public services</td>
<td>14.8</td>
<td>14.9</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Defence</td>
<td>4.1</td>
<td>2.8</td>
<td>-1.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Public order and safety</td>
<td>5.5</td>
<td>4.7</td>
<td>-0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Economic affairs</td>
<td>12.4</td>
<td>9.8</td>
<td>-2.6</td>
<td>0.3</td>
</tr>
<tr>
<td>Environment protection</td>
<td>1.2</td>
<td>1.3</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Housing and community amenities</td>
<td>0.8</td>
<td>0.7</td>
<td>-0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Health</td>
<td>12.1</td>
<td>15.8</td>
<td>3.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Recreation, culture and religion</td>
<td>2.3</td>
<td>2.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Education</td>
<td>16.9</td>
<td>15.7</td>
<td>-1.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Social protection</td>
<td>29.9</td>
<td>32.0</td>
<td>2.1</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>100.0</td>
<td>-</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Latvia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public services</td>
<td>12.1</td>
<td>13.2</td>
<td>1.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Defence</td>
<td>3.6</td>
<td>2.4</td>
<td>-1.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Public order and safety</td>
<td>6.7</td>
<td>5.2</td>
<td>-1.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Economic affairs</td>
<td>13.4</td>
<td>13.0</td>
<td>-0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Environment protection</td>
<td>1.4</td>
<td>1.8</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Housing and community amenities</td>
<td>3.6</td>
<td>3.3</td>
<td>-0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Health</td>
<td>9.7</td>
<td>10.0</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Recreation, culture and religion</td>
<td>3.6</td>
<td>4.2</td>
<td>0.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Education</td>
<td>17.1</td>
<td>15.7</td>
<td>-1.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Social protection</td>
<td>28.8</td>
<td>31.2</td>
<td>2.4</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>100.0</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Estonia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public services</td>
<td>9.1</td>
<td>10.3</td>
<td>1.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Defence</td>
<td>4.0</td>
<td>4.7</td>
<td>0.7</td>
<td>0.1</td>
</tr>
<tr>
<td>Public order and safety</td>
<td>6.4</td>
<td>4.9</td>
<td>-1.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Economic affairs</td>
<td>11.2</td>
<td>12.5</td>
<td>1.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Environment protection</td>
<td>2.0</td>
<td>1.7</td>
<td>-0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Housing and community amenities</td>
<td>0.9</td>
<td>1.4</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Health</td>
<td>12.2</td>
<td>13.0</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Recreation, culture and religion</td>
<td>6.4</td>
<td>5.4</td>
<td>-1.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Education</td>
<td>18.3</td>
<td>15.4</td>
<td>-2.9</td>
<td>0.3</td>
</tr>
<tr>
<td>Social protection</td>
<td>29.5</td>
<td>30.7</td>
<td>1.2</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>100.0</td>
<td>-</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Source: Authors calculations based on Eurostat data 2004-2013
Taking into consideration the intensity rates of structural changes of government expenditure patterns, no significant variations have been noticed across the countries. The intensity rate of structural changes has been 1.2 percentage points in Lithuania and Estonia and 1 percentage point in Latvia.

Table 2 has represented the patterns of government expenditure and their structural trends in the Scandinavian countries.

| Table 2. Government expenditure and its structural changes in the Scandinavian countries |
|---------------------------------|-----------|------------------|-----------------|
| Country/ General government expenditure by function | 2004 | 2013 | Absolute structural change, percentage points | Intensity of structural change, percentage points |
| **Denmark** | | | | |
| Public services | 13.5 | 13.6 | 0.1 | 0.0 |
| Defence | 2.7 | 2.4 | -0.3 | 0.0 |
| Public order and safety | 1.8 | 1.8 | 0.0 | 0.0 |
| Economic affairs | 6.5 | 6.3 | -0.2 | 0.0 |
| Environment protection | 1.1 | 0.7 | -0.4 | 0.0 |
| Housing and community amenities | 0.8 | 0.5 | -0.3 | 0.0 |
| Health | 13.6 | 15.3 | 1.7 | 0.2 |
| Recreation, culture and religion | 3.3 | 3.2 | -0.1 | 0.0 |
| Education | 12.5 | 12.3 | -0.2 | 0.0 |
| Social protection | 44.2 | 43.9 | -0.3 | 0.0 |
| **Total** | 100.0 | 100.0 | - | 0.2 |
| **Sweden** | | | | |
| Public services | 14.5 | 14.6 | 0.1 | 0.0 |
| Defence | 3.3 | 2.8 | -0.5 | 0.1 |
| Public order and safety | 2.4 | 2.6 | -0.2 | 0.0 |
| Economic affairs | 7.5 | 8.1 | 0.6 | 0.1 |
| Environment protection | 0.6 | 0.6 | 0.0 | 0.0 |
| Housing and community amenities | 1.5 | 1.4 | -0.1 | 0.0 |
| Health | 12.3 | 13.1 | 0.8 | 0.1 |
| Recreation, culture and religion | 1.8 | 2.0 | 0.2 | 0.0 |
| Education | 12.7 | 12.4 | -0.3 | 0.0 |
| Social protection | 43.4 | 42.4 | -1.0 | 0.1 |
| **Total** | 100.0 | 100.0 | - | 0.4 |
| **Finland** | | | | |
| Public services | 14.2 | 14.4 | 0.2 | 0.0 |
| Defence | 3.0 | 2.6 | -0.4 | 0.0 |
| Public order and safety | 2.6 | 2.4 | 0.0 | 0.0 |
| Economic affairs | 9.5 | 8.2 | -1.3 | 0.1 |
| Environment protection | 0.6 | 0.4 | -0.2 | 0.0 |
| Housing and community amenities | 0.6 | 0.7 | 0.1 | 0.0 |
| Health | 13.3 | 14.5 | 1.2 | 0.1 |
| Recreation, culture and religion | 2.2 | 2.5 | 0.3 | 0.0 |
| Education | 12.6 | 11.2 | -1.4 | 0.2 |
| Social protection | 41.4 | 43.1 | 1.7 | 0.2 |
| **Total** | 100.0 | 100.0 | - | 0.7 |

Source: Authors calculations based on Eurostat data 2004-2013
The breakdowns of general government expenditure on the basis of the activities they support (Table 2) have revealed that government spending on social protection has dominated in the Scandinavian countries as well as in the Baltic economies. In 2013, social protection activity in total government expenditure amounted to around 44 percent in Denmark, 42 percent in Sweden and 43 percent in Finland. The spending on health and public services has followed. Over the period of 2004 – 2013, Denmark and Sweden have reported the most significant shifts in health. In Denmark and Sweden, spending for health has increased by 1.7 and 0.8 percentage points respectively. In Finland, the most significant structural changes have been in spending of social protection (increase of 1.7 percentage points), education and economic affairs (decrease of 1.4 and 1.3 percentage points respectively).

The intensity rate of structural changes has varied across the Scandinavian countries. It has amounted to 0.2 percentage points in Denmark, twice greater in Sweden and 0.7 percentage points in Finland.

In general, it could be concluded, that over the period of 2004 – 2013, government spending on social protection has dominated in the Baltic countries as well as in the Scandinavian, however the patterns’ volatility of the Baltic countries has been greater than in Scandinavian. It could be interpreted as a sign of the Scandinavian countries ability to adjust to changes in international economy.

Another statistical indicator, which has been applied for the investigation of the structures of government expenditure across the countries, is Finger-Kreinin index of the patterns’ dissimilarity. Next section has been devoted for this issue.

B. Assessing of the government expenditure patterns’ dissimilarity

In order to assess the patterns of the government expenditure dissimilarity across the countries, Finger-Kreinin index has been applied. This index has summarized how much a given distribution of government expenditure differs from other country. Finger-Kreinin index ranges between 0 and 1. When value is equal to 0, this means that the structures of pair of countries being considered are identical; and when it is equal to 1, this means maximum dissimilarity.

Table 3 gives the Finger-Kreinin index of government expenditure patterns for all pairings for the period of 2004 – 2013.

According to the index value in the period of 2004 – 2013, some sightings can be identified. In general, the structures of government expenditure across the countries being observed have been similar. Finger-Kreinin index has varied in the interval of 0.025 – 0.214. It has shown low degree of dissimilarity. Assessing the pairs of the countries, the most significant dissimilarity has been revealed between the government expenditure structures of Latvia and Denmark, Estonia and Denmark, Latvia and Sweden as well as Latvia and Finland. Finger-Kreinin index has suggested that Finland and Sweden, Denmark and Finland as well as Denmark and Sweden have the lowest rate of dissimilarity in distribution of government expenditure. Finally, it could be concluded, that the patterns of general government expenditure have been more similar among the Scandinavian countries than the Baltic ones.

Next section summarizes the results of the research and provides the main insights.

IV. CONCLUSIONS

After the surveying theoretical and empirical material on structural changes, we have presented a descriptive analysis of long-term trends in the structure of general government expenditure of the Baltic and Scandinavian countries. To better understanding of these changes, we have conducted a more detailed analysis of general government distributions across the countries.

Taking into consideration the Baltic and Scandinavian countries, advanced economies differ over the aggregate scope of general government expenditure. On average, the Scandinavian countries have reported 53 percent government expenditure share relative to GDP. In contrast, the share of government expenditure relative to GDP has amounted on average to 38 percent in the Baltic countries.

In general, we might conclude that the Scandinavian countries tend to show more stability than the Baltic countries. The breakdowns of general government expenditure on the basis of the activities they support have revealed that government spending on social protection has dominated in the Baltic as well as Scandinavian countries. Education and public services have followed in the Baltic countries. In the Scandinavian countries, the next most important spending has been health and public services.

For a long time, the structural change has been accompanied by rising expenditure on social protection in the Baltic countries and health in the Scandinavian countries.

Lithuania and Estonia have shown the highest intensity rate of structural changes in 2004 – 2013, due to the sharp shifts in health, social protection and economic affairs as well in Lithuania; and economic affairs, social protection and education in Estonia. The structure of the government expenditure has changed more rapidly in the Baltic countries than in Scandinavian as an effect of the transition process and abilities to adjust to changes in the international markets.

<table>
<thead>
<tr>
<th>Countries (Average Data)</th>
<th>Lithuania</th>
<th>Latvia</th>
<th>Estonia</th>
<th>Denmark</th>
<th>Sweden</th>
<th>Finland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithuania</td>
<td>1</td>
<td>0.094</td>
<td>0.076</td>
<td>0.136</td>
<td>0.127</td>
<td>0.111</td>
</tr>
<tr>
<td>Latvia</td>
<td>0.094</td>
<td>1</td>
<td>0.075</td>
<td>0.214</td>
<td>0.185</td>
<td>0.189</td>
</tr>
<tr>
<td>Estonia</td>
<td>0.076</td>
<td>0.075</td>
<td>1</td>
<td>0.200</td>
<td>0.174</td>
<td>0.175</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.136</td>
<td>0.214</td>
<td>0.200</td>
<td>1</td>
<td>0.051</td>
<td>0.045</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.127</td>
<td>0.185</td>
<td>0.174</td>
<td>0.051</td>
<td>1</td>
<td>0.025</td>
</tr>
<tr>
<td>Finland</td>
<td>0.111</td>
<td>0.189</td>
<td>0.175</td>
<td>0.045</td>
<td>0.025</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Authors calculations based on Eurostat data of 2004-2013.
Finger-Kreinin index has suggested that the distributions of general government expenditure have had the lower rate of dissimilarity among the Scandinavian countries than the Baltic. The most significant dissimilarity has been revealed between the government expenditure structures of Latvia and Denmark as well as Estonia and Denmark. Finland and Sweden have demonstrated the lowest rate of dissimilarity in their government expenditure patterns.

REFERENCES


Determination of the weights of criteria of a company’s environment for the development of an effective company strategy
Romualdas Ginevičius¹, Aleksandr Ostapenko²

Abstract
The successful development of a company’s strategy, which determines the best corporate performance, is mainly affected by its environment which is defined by multidimensional assessment criteria acting in different directions. The incorporation of all such criteria into one generalising and complex dimension is enabled by multi-criteria assessment methods. The article examines the theoretical substantiation of the application of multi-criteria assessment techniques and their practical adaptation in determining the criteria weights of a company’s environment so as to develop an effective strategy.

Index Terms: company’s environment, company’s strategy development, multi-criteria methods, determination of the weights of criteria.

JEL: M2, O10.

I. INTRODUCTION

For a company to develop in a successful manner, it has to continuously adapt to the ever-changing environment, and to understand the potential impact of environmental factors on the performance results of the company as early as possible. It is critical that the company’s environment be fully assessed in order develop an effective strategy. This assessment of where the company is now in terms of its environment determines the choice of strategy. The aim of the article is to determine the weights of the criteria of a company’s environment for the development of an effective strategy using the techniques of multi-criteria assessment.

A company’s environment is a complicated and complex phenomenon from the point of view of developing an effective strategy. To evaluate it quantitatively a hierarchy-based system of criteria (Ginevičius, 2007) must be developed. To this end the criteria used in theoretical models (Bocken et al., 2015; O’Shaughnessy, 2014; Evans & Short 2013; Everett, 2014; Zavadskas & Turskis, 2011 and others) which affect the corporate environment in terms of strategy development were analysed. A company’s environment was defined in an objective and structured manner using a hierarchical system of 43 different criteria, with different impact on a common result (Table 4).

As criteria are multi-dimensional and act in different directions, multi-criteria assessment techniques enable them to be merged into one complex dimension which can then be used to develop a strategy. Values and weights must be set for the criteria of the company’s environment for the application of these methods.

II. RANKING OF CORPORATE ENVIRONMENT CRITERIA AND DETERMINATION OF WEIGHTS FOR THE DEVELOPMENT OF A COMPANY STRATEGY

To set weights for the criteria subjective methods are used where specialists’ (experts’) opinions constitute the basis of assessment (Ginevičius & Podvezko, 2003; 2004a; 2004b; Zavadskas et al., 2004; Hokkannen & Salminen, 1997; Ginevičius et al., 2004) as well as objective ones – where specific values of weights depend on the structure of the block of criteria details (Ustinovičius, 2001; Huang & Yoon 1981). Furthermore, subjective and objective weights can be generalised and combined in an integral manner (Fan et al., 1977; Beuthe & Scanella, 2001; Ustinovičius, 2001). Of these three, the subjective measurement is the main one; however, it requires high expert qualification since it determines the accuracy of their evaluation. Besides, if they are not sufficiently qualified, contradictory results may be obtained. For this reason, criteria weights may be adjusted to the multi-criteria assessment, if the degree of compatibility of expert assessment is fixed. This is determined by the coefficient of concordance which is calculated on the basis of ranking the compared objects. The result of expert evaluations is the matrix \( E = \left[ c_{ij} \right] \) \((i=1, \ldots, m; j=1\ldots, r)\), where \(m\) is the number of compared criteria (objects), and \(r\) is the number of experts. Experts can assess the expected value in different ways. For the assessments, any scale of measurement can be applied, for example, measuring in criteria units, percentage, unit fractions, ten-grade system or Saaty’s pair-wise comparison scale (Saaty, 2008). To calculate the dispersal coefficient of concordance, however, only the ranking of expert criteria can be used. Ranking is the procedure where the most important criterion is attributed the rank which is equal to one point, the second criterion in terms of importance is given two points, etc. and the least important criterion is given rank \(m\); where \(m\) is the number of compared criteria. Equivalent criteria are

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attributed the same value, namely, the arithmetic mean of ordinary ranks.

The results of the determination of criteria ranks can be applied in practice, if a sufficient level of compatibility of expert opinions is set. Expert opinions and attitudes to the problem being solved often differ and can even be controversial. The compatibility of opinions is determined by the coefficient of concordance which is calculated on the basis of the ranking of compared criteria. The dispersal coefficient of concordance was defined by M. Kendall (1970). The idea of the coefficient was linked to the number of ranks of each criterion $c_i$ with regard to all experts:

$$c_i = \sum_{j=1}^{r} \gamma_{ij},$$

(1)

to be precise, (it was linked) to the variation of dimensions $c_i$ from the total mean $\overline{c}$ by the total sum of squares $S$ (the analogue of dispersion):

$$S = \sum_{i=1}^{m} (c_i - \overline{c})^2.$$  

(2)

The total mean value $\overline{c}$ is calculated according to the formula:

$$\overline{c} = \frac{\sum_{i=1}^{m} c_i}{m} = \frac{\sum_{i=1}^{m} \sum_{j=1}^{r} \gamma_{ij}}{m}.$$  

(3)

If $S$ is a real amount of squares calculated in accordance with formula (2), the concordance coefficient $W$ is calculated in accordance with the following formula (Kendall, 1970):

$$W = \frac{12S}{r^2m(m^2-1)}.$$  

(4)

If the opinions of experts are harmonised, the value of the concordance coefficient $W$ is close to 1, whereas, if the assessment differ considerably, the value of $W$ is close to zero.

Kendall proved that (Kendall, 1970) if the number of objects $m > 7$, the significance of the concordance coefficient may be determined using the criterion $\chi^2$:

$$\chi^2 = Wr(m-1) = \frac{12S}{rm(m+1)}.$$  

(5)

A random value is distributed according to the distribution $\chi^2$ with the degree of freedom $\nu=m-1$. The number of freedom degrees $\nu$ of distribution $\chi^2$ does not depend on the number of experts $r$ because it is used to measure the difference between the total number of rankings only. The critical value $\chi_{\nu}^2$ is determined according to the level of importance $\alpha$ (in practice, the value $\alpha$ usually equals to 0.05 or 0.01) chosen from the table of the distribution $\chi^2$ with the degree of freedom $\nu=m-1$. If the value of $\chi^2$ calculated according to formula (5) is higher than $\chi_{\nu}^2$, then the evaluations of the experts are coordinated (Podvezko, 2005).

The hierarchical structure of the system of the company’s environment criteria in order to develop an effective strategy provided in Table 4 was used to draw up a ranking questionnaire which had to be completed by highly qualified experts of strategic management who had to evaluate the significance of the rankings of the environment criteria (internal and external, competitive advantage, financial situation, structure of the industry, economic, technological, social and political environment. The importance of the company’s environment criteria was measured by 10 highly qualified specialists. Every criterion was given a rank from 1 (to the first most significant) to $m$ (to the least significant). The compatibility of experts’ opinions was also verified.

The ranking results of the criteria of the company’s competitive advantage are provided in Table 1.

<table>
<thead>
<tr>
<th>Seq. No</th>
<th>Criterion</th>
<th>Expert</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>The total of the rankings</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The share taken by the industry</td>
<td>8 6 9 3 9 1 1 1 6 4</td>
<td>48 6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The general level of the company’s competences</td>
<td>7 7 3 7 2 5 2 9 4 6</td>
<td>52 7</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Technological advantage of the company</td>
<td>6 4 1 4 1 7 4 2 3 2</td>
<td>34 1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Flexibility</td>
<td>3 3 2 2 3 6 3 6 2 9</td>
<td>39 2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>The potential to compete by means of price and quality</td>
<td>2 5 6 5 4 3 5 5 5 1</td>
<td>41 3</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>The strength of the brand</td>
<td>9 2 4 6 7 2 6 3 1 3</td>
<td>43 4</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>The level of client satisfaction</td>
<td>1 1 7 1 5 4 7 7 7 5</td>
<td>45 5</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>The potential of the manufacturing capacity</td>
<td>4 8 8 8 8 9 4 8 7</td>
<td>72 8</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>The company’s access to funding</td>
<td>5 9 5 9 6 9 8 8 9 8</td>
<td>76 9</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Referring to Table 1, it was determined that the sum of the variations of squares $S$, which was calculated according to formula (2), amounts to $S = 1700$, the coefficient of concordance $W$ calculated according to formula (3) amounts to $W = 0.283$, the value of $\chi^2$ according to
formula (5), which is $\chi^2 = 22.667$, exceeds the critical $\chi^2 = 15.507$ with the level of importance $\alpha = 0.05$ and degree of freedom $\nu = 9 - 1 = 8$. All this shows that the opinions of the experts were harmonised. The criteria defining the financial situation of the company are provided in Table 2.

**TABLE II**

**THE FINANCIAL SITUATION CRITERIA – RANKING RESULTS**

<table>
<thead>
<tr>
<th>Seq. No</th>
<th>Criterion</th>
<th>Expert</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>The total of the rankings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Return on investment</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>42</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Profit margin</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Debt-to-equity ratio</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>52</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Sales</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Profitability</td>
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<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>17</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Asset strength index</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>66</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Revenue by product</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>53</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Ratio between fixed and variable costs</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>67</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Referring to Table 2, the sum of variations of squares $S$ calculated according to formula (2) was determined to be $S = 2279$, the coefficient of concordance $W$ calculated according to formula (3) was determined to be $W = 0.543$, it was determined that the value of $\chi^2$ calculated according to formula 5, namely, $\chi^2 = 37.984$ exceeded the critical $\chi^2 = 14.067$ with the level of importance $\alpha = 0.05$ and the degree of freedom $\nu = 8 - 1 = 7$. This shows that the opinions of the experts were harmonised.

The criteria of the structure of the industry, economic environment, technological environment, social environment, political environment, internal and external environment were ranked in the same way.

Following the check of the compatibility of the experts’ opinions according to the collected data of the ranking questionnaire, a second questionnaire was designed for highly qualified experts to determine the values of the analysed criteria weights by fractions of a unit and the technique of direct assessment was adapted.

The weights of the criteria defining the competitive advantage of a company by fractions of a unit specified by the ten experts are provided in Table 3. The criteria of the company’s technological advantage, flexibility, potential to compete by means of price and quality and the strength of a brand were measured as the most important ones, meanwhile, the weights of other criteria differ only slightly. The criteria of the potential of the manufacturing capacity and the company’s access to funding were indicated as having the least significance.

**TABLE III**

**THE WEIGHTS OF CRITERIA OF COMPETITIVE ADVANTAGE**

<table>
<thead>
<tr>
<th>Seq. No</th>
<th>Criterion</th>
<th>Expert</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>Mean of weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The share taken by the industry</td>
<td>0.1</td>
<td>0.12</td>
<td>0.04</td>
<td>0.09</td>
<td>0.09</td>
<td>0.06</td>
<td>0.08</td>
<td>0.07</td>
<td>0.04</td>
<td>0.1</td>
<td>0.079</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The general level of the company’s competences</td>
<td>0.06</td>
<td>0.08</td>
<td>0.02</td>
<td>0.08</td>
<td>0.08</td>
<td>0.05</td>
<td>0.07</td>
<td>0.06</td>
<td>0.03</td>
<td>0.06</td>
<td>0.059</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Technological advantage of the company</td>
<td>0.2</td>
<td>0.17</td>
<td>0.3</td>
<td>0.16</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
<td>0.21</td>
<td>0.5</td>
<td>0.19</td>
<td>0.243</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Flexibility</td>
<td>0.19</td>
<td>0.16</td>
<td>0.3</td>
<td>0.15</td>
<td>0.19</td>
<td>0.29</td>
<td>0.15</td>
<td>0.2</td>
<td>0.15</td>
<td>0.18</td>
<td>0.196</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>The potential to compete by means of price and quality</td>
<td>0.15</td>
<td>0.15</td>
<td>0.2</td>
<td>0.15</td>
<td>0.15</td>
<td>0.08</td>
<td>0.14</td>
<td>0.2</td>
<td>0.1</td>
<td>0.17</td>
<td>0.149</td>
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</tr>
<tr>
<td>6</td>
<td>The strength of the brand</td>
<td>0.14</td>
<td>0.15</td>
<td>0.06</td>
<td>0.14</td>
<td>0.1</td>
<td>0.08</td>
<td>0.13</td>
<td>0.09</td>
<td>0.1</td>
<td>0.15</td>
<td>0.114</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>The level of client satisfaction</td>
<td>0.13</td>
<td>0.14</td>
<td>0.05</td>
<td>0.11</td>
<td>0.1</td>
<td>0.07</td>
<td>0.12</td>
<td>0.08</td>
<td>0.05</td>
<td>0.12</td>
<td>0.097</td>
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</tr>
<tr>
<td>8</td>
<td>The potential of the manufacturing capacity</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.07</td>
<td>0.05</td>
<td>0.04</td>
<td>0.06</td>
<td>0.05</td>
<td>0.02</td>
<td>0.02</td>
<td>0.037</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>The company’s access to funding</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.05</td>
<td>0.04</td>
<td>0.03</td>
<td>0.05</td>
<td>0.04</td>
<td>0.01</td>
<td>0.01</td>
<td>0.026</td>
<td></td>
</tr>
</tbody>
</table>
The weights of the criteria of the company’s environment for the development of a strategy were measured in the same way; they are provided in Table 4 below.

**TABLE IV**

WEIGHTS OF CRITERIA OF CORPORATE ENVIRONMENT FOR THE DEVELOPMENT OF AN EFFECTIVE STRATEGY

<table>
<thead>
<tr>
<th>Corporate environment for the development of an effective strategy</th>
<th>Internal environment</th>
<th>0.387</th>
<th>Financial situation</th>
<th>0.582</th>
</tr>
</thead>
<tbody>
<tr>
<td>The share taken by the industry</td>
<td>0.418</td>
<td>Competitive advantage</td>
<td>0.079</td>
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</tr>
<tr>
<td>The general level of the company’s competences</td>
<td>0.059</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technological advantage of the company</td>
<td>0.243</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>0.196</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The potential to compete by means of price and</td>
<td>0.149</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The strength of the brand</td>
<td>0.114</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The level of client satisfaction</td>
<td>0.097</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The potential of the manufacturing capacity</td>
<td>0.037</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The company’s access to funding</td>
<td>0.026</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return on investment</td>
<td>0.109</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit margin</td>
<td>0.142</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt-to-equity ratio</td>
<td>0.089</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>0.214</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profitability</td>
<td>0.264</td>
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<td></td>
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<tr>
<td>Asset strength index</td>
<td>0.064</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Revenue by product</td>
<td>0.078</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio between fixed and variable costs</td>
<td>0.040</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The company’s susceptibility to R&amp;D</td>
<td>0.068</td>
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<tr>
<td>Entrance barriers</td>
<td>0.190</td>
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<tr>
<td>Elasticity of demand</td>
<td>0.076</td>
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<tr>
<td>Seasonality of the industry</td>
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<tr>
<td>Level of competition</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Price level</td>
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</tr>
<tr>
<td>Size of the industry</td>
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<td></td>
<td></td>
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<tr>
<td>General risk level</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Level of profitability of the industry</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Interest rate</td>
<td>0.111</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government expenditure</td>
<td>0.077</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic growth</td>
<td>0.275</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Unemployment</td>
<td>0.180</td>
<td></td>
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</tr>
<tr>
<td>Inflation</td>
<td>0.211</td>
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<td></td>
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</tr>
<tr>
<td>Economic recession and its effects</td>
<td>0.147</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Patent protection</td>
<td>0.139</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>IT developments</td>
<td>0.240</td>
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<tr>
<td>R&amp;D activity</td>
<td>0.184</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy resource prices</td>
<td>0.112</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology transfer level</td>
<td>0.324</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchasing power</td>
<td>0.317</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income distribution</td>
<td>0.338</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pace of population growth</td>
<td>0.196</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply of labour power</td>
<td>0.149</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D regulation</td>
<td>0.301</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government regulation</td>
<td>0.699</td>
<td></td>
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</tr>
</tbody>
</table>
Following the determination of ranks and weights which define the environment of a company, it is possible to carry out the quantitative assessment of the criteria of the corporate environment for the development of an effective strategy using multi-criteria assessment techniques.

III. CONCLUSION

An effective corporate strategy is developed after an objective assessment of its internal and external environment is carried out. For this, techniques which allow a phenomenon to be objectively evaluated and decisions to be made, which would ensure the best results of corporate performance, are required.

A company’s environment is a complex phenomenon for the development of an effective strategy. To assess it in a quantitative manner, a hierarchical structure of the criteria of a company’s environment intended for the development of an effective strategy was developed. The hierarchical structure of criteria describes the corporate environment in detail, and enables the most important aspects of the environment to be defined in a structured way, and the impact which the analysed criteria might have on the common result to be anticipated.

To assess the environment of a company in order to develop an effective strategy by applying the multi-criteria assessment techniques, all environmental criteria have to be incorporated into one generalising dimension, the weights and values of the analysed criteria have to be determined. The weights of criteria and their groups were defined following the determination of criteria rankings and the verification of their compatibility.

REFERENCES

Indicators for conflict of interest in public procurement financed by the EU Structural funds

Ina Lecheva

Abstract. Public procurement activity, filled with many preconditions for the emergence of irregularities and fraud. The conflict of interest is inherently corrupt practice extending through the entire process of assignment and performance. Indicators of conflict of interest are an important part of knowledge that should have recognition of the illegal practices that will enable the protection of the financial interests of the Community. Indicators of conflict of interest are an important part of knowledge that we should have for recognition of the illegal practices that will enable the protection of the financial interests of the Community.

Index Terms: Indicators of conflict of interest, conflict of interest, public procurement irregularities, fraud

JEL: G28, H57, H83.

I. INTRODUCTION

The management of conflict of interest is a huge challenge for managers, whether they are part of public or corporate sector. Increasingly commercial public sector that works closely with businesses and NGOs raises the possibility of the emergence of new forms of conflict of interest between public sector employees and those from private, in the performance of their duties.

Lack of proper identification and management of conflicts of interest can lead to serious harm in achieving the organization's objectives, compromising its entirety and availability of corrupt practices.

A key point in the prevention of conflict of interest is increased awareness and conversance among the society and businesses. The Requirements for impartial and transparent decision-making by the government is a tool for reducing corruption practices in compliance with the rules of fair and loyal competition.

Protection of the financial interests of community regarding to the conflict of interests are defined in the general Financial Regulation, according to which: "The conflict of interests exists where the impartial and objective exercise of the functions of a financial participant or other person is flawed for reasons involving family, emotional life, political or national affinity, economic interest or any other interest that is common with that of recipient."

In national legislation is defined that conflict of interest arises when a person holding public position has a private interest that could affect the impartial and objective performance of the powers and duties of his office.

In the area of public procurement, conflict of interest is regulated on one hand as a ban on participation of members and consultants in committee in the examination, evaluation and ranking of offers and the other for non-participation in a contract to persons who have contracted with persons having restrictions after their release from public position.

As a result of community requirements, for the new programming period is accepted new law on public procurement, which introduces more detailed requirements regarding conflicts of interest. Subsequently, the requirements for openness and transparency, the successful introduction and implementation of the policy management of conflicts of interest aimed to minimize the risks and correct any problems. Of particular relevance to policy implementation is the knowledge of key indicators – so called "Red flags" in procurement.

II. INDICATORS OF CONFLICT OF INTEREST IN PUBLIC PROCUREMENT "RED FLAGS"

Indicators or so called "Red flags" are the item or set of items that are unusual or untypical in nature and digness from normal activity. This is a signal that something is

2 Art. 2 para. 1 of the Law on Prevention and Disclosure of Conflict of Interest prom. SG. 94 of 31/10/2018, last. amend. and supplemented. SG. 12 g 02/13/2015
3 Art. 35, para. 1 pt. 3 and art. 47, para. 5 pt. 2 of the Public Procurement Act, SG. 28 of 2004, last. amend. SG. 13 of 2016 in force until 15/04/2016
4 Public Procurement Law, promulgated. SG. 13 of 2016 effective from 15.04.2016
5 Managing Conflict of Interest in the Public Service OECD Guidelines and country experiences
wrong and needs to be further investigated for any possible irregularity or fraud. The presence of such an indicator is not always the reason for irregularity or fraud.

In assignment and execution of procurement can meet many indicators showing abnormalities and anomalies in regard to:

- documentation for participation in the procedure;
- financial aspects of the contract;
- anomalies in the behavior of employees.

The presence of indicators should raise the attention of employees and managers of the contracting authority. They should take the necessary measures to confirm or reject the suspicion of conflict of interest. It is essential to respond to appeared "red flags." The presence of these indicators does not necessarily mean there is a fraud and a need to undertake a detailed examination of the circumstances and caution and monitor of manifestation.

Assignor, respectively MA \ IB is responsible for preventing and checking all doubts connected with appearance of "red flag." 6

Typical cases of suspected irregularities and fraud in connection with conflicts of interest in the conduction of public procurement during the various stages are associated with a number of indicators.

These indicators at times may seem ordinary and are valid for many different situations. It should be borne in mind that the "red flags" are indicators that aim inspections in order to confirm or reject the presence of irregularity or fraud.

According to the guide for establishing the conflict of interest in procurement procedures for structural actions 6, the indicators are grouped into three conditional groups according to the stage of the procedure or its implementation as follows:

1. Preparing and starting the procedure

The questions related to conflict of interest are relevant at this preliminary stage of the procedure. Depending on the type of proceedings, connected with the documentation for participation the assigner may require external studies or to be provided advice from external bodies or experts.

At this stage it is essential determining the type of procedure, preparation of documents for participation, evaluation methods, specifications, project offer and contract.

Red flags:

- abnormal behavior employee who insists on receiving information on the procedure, although he is not responsible for it;
- an employee of the contracting authority has relatives/close people who work for the company, submitted an offer;
- an employee of the contracting authority worked for a company that may represent an offer just before to be assigned at work in contracting.
- senior official \ person responsible for the preparation of documentation requires hiring outside experts to prepare the documentation on supposition that there is no need;
- exerting the pressure of a specific study in preparation of procedure documentation;
- the person responsible for the preparation of the procedure provides the documents with such a delay that it has no time to perform thorough and careful examination of the documents before starting of the procedure;
- choice of a negotiated procedure in the presence of conditions for the open procedure;
- for a very short time are assigned two or more contracts with the same subject in restriction of competition;
- There are unsubstantiated selection criteria or selection that benefit a specific company or an offer;
- rules for the provision of goods or services are too stringent and restrictive and only allow a company to represent an offer;

2. Providing offers, review, ranking and selection of a contractor.

After the expiry of the deadline for submission of proposals, the contracting authority shall appoint a committee for examination, evaluation and ranking of the offers received.

If not clear questions exist, the Evaluation Committee may require the submission of additional evidence or clarification of questions. Decisions on acceptance of the documents and the explanations are provided to the Commission that on the basis of their work offers the assignor with ranking of participants and remove those that do not meet preset conditions. The decision to select a contractor is up to the assignor or person authorized by him.

Red flags:

- There are obvious changes in official documents and / or certificates of obtaining documents (for example scratching out, addition, etc.);
- Members of the Evaluation Committee do not have the specific expertise to assess the offers submitted by only one person with specific competencies;
- methodology for estimation is with too much weight of subjective elements;
- missing mandatory information from the participant won the procedure;
- information provided by the participant who won is associated with an employee of the assignor (for example address of the employee, telephone number, e-mail address);
- address of the successful assignor is incomplete referred only mailbox, no phone number and address (fictitious company).
- specifications are very similar to the products or services to the winning participant, especially if the specifications include a set of very specific requirements that very few actors can perform;

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6 Identifying conflicts of interests in public procurement procedures for structural actions. A practical guide for managers, p. 22-25
• small number of companies which have bought documents for participation give offers, especially if more than half quit;
  • it is signed a contract with an unknown company with no experience in the subject.

3. Contract procurement, amendment and implementation.

One of the main requirements related to the implementation of contracts following a public procurement procedure, is to be executed according to predefined requirements and parameters according to the technical specifications, proposed period and value. Allowing amendments to existing contracts is permitted only under certain conditions and motivation on the part of the initiating party.

Red flags:
 • modification of standard contract clauses (control implementation, penalties and damages, remedies, etc.);
 • specifications, schedule, offer etc. are not applied to the contract;
 • the name and legal form of the company have changed and the official responsible is not informed anyone for the change;
 • numerous or suspicious orders for changes are made in a particular with a contractor approved by the same officer;
 • for large orders it is observed long and unexplained delay between the announcement of the participant won the procedure and the signing of the contract (the contractor may refuse to pay or negotiate at the request of bribery);
 • made significant changes in the technical specifications or conditions of implementation;
 • the quality of the items that should be supplied is reduced without a corresponding reduction in payment;
 • operating hours are increased without a corresponding increase in the materials used;
 • lack of contract or documentation on which to justify a specific purchase;
 • working with the file, the behavior of the person responsible is unusual: he did not answer questions from management about unexplained delays, anticipation and missing documents;
 • there are many complaints and canceled procedures in procurement;
 • there are changes in the quality, quantity or specification of goods and services under the contract, which deviate from the tender documentation (conditions, technical specifications, etc.).

IV. CONCLUSIONS

The appearance of indications of conflict of interest is a manifestation that should not be overlooked. Verification of red flags will frustrate and prevent multiple corruption, irregularities and fraud in the award and execution. The assignor should establish clear policies defining steps and levels of checks to declare conflicts of interests and taking corrective action when they occur.

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Abstract The paper offers methodological guidance for efficient project risk management. To that end, the essence of the terms “uncertainty”, “risk” and “project risk” is firstly explained; a review of the concepts and models of project risk assessment, existing in the specialized literature, is developed; the most popular and frequently used quantitative and qualitative methods for project risk assessment are presented in brief; the different elements of the project risk management process are presented in details. The thesis that project risk cannot be fully eliminated is sustained. Yet, through purposeful and continuous actions, it could be forecasted and managed.

Index Terms: risk, project risk, project risk management, project-oriented organizations

JEL: D81, O22, M21

I. INTRODUCTION

Modern organizations tend to increasingly use the project-oriented approach as a response to the dynamically changing environment. The growth of competition, necessity of timely and adequate response to market changes, need of prompt adaptation to changes in the environment, limited resources are all only a part of the major reasons that force organizations to apply project management principles and methods.

Managing a certain project is a temporary, unique, nonrecurring activity, hiding a number of risks. This makes project management rather difficult and further consolidates the key role of the effective management in the progress of project implementation. In order to successfully cope with this task, i.e. to measure the actual outcome of the project activities on a regular basis, to compare them to the plan indicators and to forthwith take corrective measures, if necessary, it is important that the project manager know in details the complete process in the progress of project implementation, have a clear idea about the project risk management and consider “the important role of project funding as an additional source of financial resources for SME, which is significant for their sustainable growth” (Bakardzhieva, R., 2003).

Implementing a unified project risk management system will not simply ensure taking adequate actions in response to identified risks that endanger proper achievement of the project objectives in the progress of project implementation but it will also facilitate the process of taking a positive decision for funding and initiation of the project.

Project risk cannot be fully eliminated but through purposeful and continuous actions it could be forecasted and managed. For the purpose, first, the sources of risk and the possible undesired events have to be identified and second, a risk analysis and assessment has to be made. Based on this assumption, this report provides methodological guidance for project risk management.

The presented guidelines are meant to systematize and illustrate the complete process of project risk management. They set up a framework designed to facilitate project managers in the development, implementation, and maintenance of a working system for risk management in a given project but in order to be effectively applied they have to be adjusted and further developed according to the specifics of each particular project.

II. ESSENCE OF THE TERM RISK

It is an important prior condition for effective project risk management to elucidate the essence of the term risk in advance.

Some authors believe that the term risk originates from the Latin word risico, meaning danger, uncertainty. Others assume that its origin lies in the Greek word rhiza, meaning root and/or precipice. The word risk appears in many European languages and it is difficult to identify how it has entered Bulgarian. According to the Dictionary of Foreign Words in the Bulgarian Language, the word risk originates from (French risqué from Italian risico). The meaning of the word is described as “a possible danger”, “a hopefully successful random action” or “a possible loss”. The meaning of the identical words in German and English is analogous.

The term risk may be discussed from two perspectives: a positive one – the possibility of achieving better results that the ones expected after taking the risk actions, and a negative one – the possibility of suffering failure and loss (Alexandrova, M., 2009, p.40). In everyday life, the term risk is more frequently used as a synonym of danger and it is associated with the occurrence of unfavorable events.

Risk has four structural elements, which describe its essence:
- Risk is always associated with some kind of danger, with the possibility of something bad happening;
- Risk is always associated with taking decisions in conditions of uncertainty;

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- Risk is always associated with the hope of achieving success;
- Risk can be measured.

In order to elucidate the essence of the term risk, we must first differentiate it from the term uncertainty. In general, the two terms, risk and uncertainty, are very close and even quite often used synonymously. Both terms are used to identify absence or lack of certainty, but while “risk is an unknown event, which might occur and can be assessed”, “the situation where the possibility of a certain event occurring is unknown and cannot be assessed using traditional methods or cannot be assessed at all, is called uncertainty” (Draganov, H., 2003, p. 18).

D. Dochev and R. Nikolaev define uncertainty as a source of risk, which needs to be minimized by collecting information. For the purposes of reducing uncertainty to zero, full and reliable information needs to be collected. Since practically, this is not always possible, the authors add: “This is why, when taking decisions in conditions of uncertainty, it needs to be formalized and the risk, arising out of it, needs to be assessed.” (Dochev & Nikolaev, 2007, p. 20).

In project management, the term risk is associated with an event or condition, which once occurring could cause positive or negative consequences for the project realization. In the context of project management, Tom DeMarco and Timothy Lister formulated the following definition for project risk: “Risk – this is a problem, which has not yet occurred, and the problem is a risk, which has already materialized. Until the moment of its manifestation, risk is simply an abstraction; it might affect the project and already materialized. Until the moment of its manifestation, has not yet occurred, and the problem is a risk, which has directly speak of management of the possible risk. The stages that they define are the following: risk identification (identification of the sources and types of risk), risk assessment (analysis of the factors and conditions that influence the probability of risk events occurring), selection of techniques and means for reducing and managing the risk, risk diversification, situational control of the risk, summary of the accumulated experience.

In their model, authors draw attention to the impact on risk management that all possible participants in a certain project have, such as producers, consumers, banks, business and industrial organizations. Another important point in their model, which is usually omitted in most project risk management models, is the summary of the accumulated experience, which the authors isolate as a different stage of the process. What they recommend is collection and processing of information about risk situations, the offered solutions and the actual outcomes; description of the consequences of occurred risk events; collection of good practices, basic conclusions, recommendations and proposals to be applied in the realization of future projects.

The model presented by Razu, Broninkova, Titov and Yakutin (2006) studies project risk management as a dynamic system, based on a set of multiple factors with great depth and complex interconnections. Project management is presented as a subsystem divided in two – project risk analysis and project risk minimization. The following methods are suggested for project risk analysis:

III. PROJECT RISK MANAGEMENT CONCEPTIONS AND MODELS

In literature, there are a number of conceptions and models for project risk management, based on standards, tested and proven in practice. Most of them are based on the theoretical developments in the field of risk management and treat project risk management as a process, which incorporates interrelated and purposeful actions for minimizing the negative impact of risk on the project outcomes.

The project risk management model presented by Gary R. Heerkens (2002) includes four stages: (1) Identification of all important and potential problems, endangering the project; (2) Quantitative assessment of the threats to the project; (3) Analysis of the threats and deciding on which of them represents greatest danger for the project; (4) Coping threats. The contribution of this model lies within its working and relatively simple approach to project risk management, which could be used in every project, irrespectively of its specifics, both by experienced project managers and by those with less experience. An important contribution of the model to project risk management is the identification of the fields with high uncertainty – scope of the project, timeframes, budget, technologies, resources, organization and external factors. Another contribution of the model is the provided list of over 60 possible problems classified in 10 groups – scope of the project, time schedule, marketing, materials, technology, resources, organization, personal, interpersonal, external influences/that go along with the project realization, which, as the author suggests, could be used as a basis during the first stage, when the possible problems are identified. He recommends using this list at a meeting of as much as possible project team members and one of the options for its use that he suggests is expanding and adjusting the list to the particular project, based on the brainstorm method.

Similar to Gary R. Heerkens’ model is the project risk management model, presented by R. Lvovich, V. Ivanovich and Ya. Vasilyevich (2000). Again they present project risk management as a process but instead of potential problems, they directly speak of management of the possible risk. The stages that they define are the following: risk identification (identification of the sources and types of risk), risk assessment (analysis of the factors and conditions that influence the probability of risk events occurring), selection of techniques and means for reducing and managing the risk, risk diversification, situational control of the risk, summary of the accumulated experience.

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Decision Tree, Game Theory, and Sensitivity Analysis, and the basic methods for risk minimization are defined as the following: diversification or distribution of risks, identification of a reserve of resources and insurance.

Each project risk management model is based on the assumption that the preliminary risk assessment, on one hand, facilitates identification of the most important areas that project managers should focus on, and on the other hand, provides guidance on how the duties related to its management should be distributed. The introduction of such a system provides information, based on which, apart from principle risk identification, the risk significance, probability of occurrence could also be determined and appropriate responses and techniques for its effective management could be considered.

IV. QUANTITATIVE AND QUALITATIVE METHODS FOR PROJECT RISK ASSESSMENT

For the purposes of project risk assessment both quantitative and qualitative methods could be used. Qualitative methods are mainly based on expert valuations, accumulated prior experience and subjectivism, while quantitative methods provide an objectively worth risk assessment. In practice, for the purposes of risk assessment and analysis, a combination of qualitative and quantitative methods is most frequently applied.

The main task of qualitative analysis in project risk assessment is to identify the sources of project risk; to define the factors that cause risk; to describe the stages and particular actions from the project life cycle, which, when implemented, could cause risk, etc., i.e. to determine the potential risk areas and thereafter, to identify all possible risks. In qualitative analysis for project risk assessment, the risk is measured in qualitative terminology, defined based on preliminary determined degrees, which allow, for example, assessment of the probability of occurrence of a particular risk as “low”, “medium” or “high”. Some of the most frequently used methods for qualitative project risk assessment are presented below.

- List of Risks – a simplified form of project risks identification; usually in the form of a table, in which typical risks are listed and classified; a specific list of the possible risks is developed for each different project; in the process of project implementation, the list could be expanded and updated;
- Brainstorm Method – a relatively easy and widely applicable method for generating thoughts and ideas related to a particular problem that has to be solved; this method allows generating a large number of ideas for a short period of time;
- Delphi Method – this method requires a collective assessment, realized with the assistance of experts; it is assumed to be one of the most reliable methods for this type of assessment; it is conducted in several stages related to the anonymous opinion of the experts and analyses of their opinion for the purposes of achieving consensus as a result; when using this method, certain conditions should be created to ensure productive work of the committee of experts;
- Fishbone Diagram – this method allows analysis of the most important reasons for a particular problem and based on it, identification of solutions for it; defining the problematic situation and identifying the reasons could be realized using the Brainstorm Method;
- Mind Maps – (intellectual maps) are a highly effective tool for reaching information in someone’s brain – they are a creative and logical instrument for taking notes; they combine words, pictures, digits, logic, rhythm, colors and space.

The quantitative analysis in project risk assessment, on the other hand, refers to identification of the numerical values and parameters of the possible types of project risk and the risk of the project in general. Quantitative methods require thorough and detailed analysis of the existing facts, which makes them a safe and reliable source of information. One of the weaknesses of quantitative methods is related to the high costs and required competence for collection of the information and its processing. Some of the most frequently used methods for qualitative project risk assessment are presented below.

- Sensitivity Analysis – it is a method that allows quick identification of the variables, which mostly contribute to the risk in a certain project;
- Fault Tree Analysis – a structured model that presents in a graphic hierarchical form the logic of the connections between the events that cause failures in a complex system; this model analyses the functioning of the system in terms of the behavior of its building elements and in connection with the elaboration of the final assessment of its reliability and associated risk;
- Bowtie Method – in the form of diagrams, the risk path is being described and analyzed – from dangers to consequences, as well as the weaknesses in the management; it could be discussed as a combination of the logic of the Fault Tree method, analyzing the reasons for a particular event (presented as the bowtie knot), and the Event Tree, analyzing the consequences;
- Monte Carlo Simulations – a universal simulation method, which finds application in different fields of research and in practice; a basic technique for studying and modeling events with high degree of uncertainty and risk; the main advantages of the approach lie in “its accuracy (it sets up a full picture of the risk), flexibility (it allows risk managers to use different theoretical distributions and dynamic correlation dependencies), generality and opportunity to be integrated in different risk modules”.

V. METHODOLOGICAL GUIDANCE FOR PROJECT RISK MANAGEMENT

Project risk management is viewed as a process, which incorporates risk identification, analysis, assessment, counteraction, monitoring and control, aiming strengthening the positive and reducing the negative consequences of the risk events occurring during project realization. In literature, there are many models and
conceptions of the different stages of the process of risk management. The described models mostly concur and mainly differ in the way the activities, included in the process, are grouped, in their number and sequence.

Based on a thorough analysis of the existing models that describe the different stages of the project risk management process, for the purposes of this report, a project risk management model is developed (see Fig. 1). Each of the stages of the process is elaborated in details in terms of the activities it incorporates, the methods that could be used, the work maps that are to be filled, the people in charge of the different activities and the expected outcomes of each stage.

Stage 1: Risk identification.
Identification of the risks that affect the project (positively or negatively) and documentation of their specifics. For the purposes of risk identification, the risk areas and the sources of risk for the project are studied and defined. The final product of this stage is a filled card of potential risk events (see Fig. 2).

<table>
<thead>
<tr>
<th>Risk factors and potential risk events</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project:</strong></td>
</tr>
<tr>
<td>Period of project realization:</td>
</tr>
<tr>
<td>Filling date:</td>
</tr>
<tr>
<td>Used method:</td>
</tr>
<tr>
<td>/questionnaires, brainstorm, scenario method, focus groups…/</td>
</tr>
<tr>
<td>Participants:</td>
</tr>
<tr>
<td>Factors:</td>
</tr>
<tr>
<td>1.</td>
</tr>
<tr>
<td>1.1.</td>
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<tr>
<td>1.2.</td>
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<td>...</td>
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<tr>
<td>2.</td>
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<tr>
<td>2.1.</td>
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<td>2.2.</td>
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</table>

Risk identification comprises the following activities:
1. Systematic study of all aspects of the activities, included in the project;
2. Defining project risk factors / sources of risk;
3. Determining potential risk events;
4. Documentation of the possible risks.

Risk identification is realized by the application of a number of methods and techniques for finding and defining the possible risks. Some of the most frequently used methods are: Brainstorm, Scenario Method; Focus Groups; STEEP Analysis; SWOT Analysis, etc.

Stage 2: Risk analysis and assessment
Risk analysis studies the identified risks and seeks the possible reasons for them. Based on this, the risks are assessed in terms of their probability of occurrence and in terms of the potential negative consequences for the project. The final product of this stage is filling in a risk assessment card, which indicates values of the probabilities of risk occurrence and values of the consequences of occurred risks (see Fig. 3).

In determining the risk components and level for different risk events, the degrees with their respective numerical values from tables 1 and 2 are used. Once the risk elements are determined, the risk ranking is identified. (see Table 3) The risk ranking is calculated according to the following formula: \( R = P \times (C_T + C_B + C_Q) / 3 \)

Probability (P) is coded as specified in Table 1, consequences (C) are coded as specified in Table 2 and the risk is classified in degrees as specified in Table 3. Based on the number of identified risks in each of the above degrees, the project can be generally classified, as specified in Fig. 4.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>PROBABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>Description of the Probability</td>
</tr>
<tr>
<td>0</td>
<td>Practically impossible</td>
</tr>
<tr>
<td>1</td>
<td>Probability is small</td>
</tr>
<tr>
<td>2</td>
<td>Probability is below average</td>
</tr>
<tr>
<td>3</td>
<td>Probability is average</td>
</tr>
<tr>
<td>4</td>
<td>Probability is above average</td>
</tr>
<tr>
<td>5</td>
<td>Probability is high</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>CONSEQUENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>Description of the Consequences</td>
</tr>
<tr>
<td>0</td>
<td>No consequences</td>
</tr>
<tr>
<td>1</td>
<td>Little</td>
</tr>
<tr>
<td>2</td>
<td>Significant</td>
</tr>
<tr>
<td>3</td>
<td>Serious</td>
</tr>
<tr>
<td>4</td>
<td>Dangerous</td>
</tr>
<tr>
<td>5</td>
<td>Catastrophic</td>
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<table>
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<tr>
<th>TABLE 3</th>
<th>RISK</th>
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<tbody>
<tr>
<td>Degree</td>
<td>Ranking</td>
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<tr>
<td>I</td>
<td>0–1</td>
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<tr>
<td>II</td>
<td>2–4</td>
</tr>
<tr>
<td>III</td>
<td>5–9</td>
</tr>
<tr>
<td>IV</td>
<td>10–16</td>
</tr>
<tr>
<td>V</td>
<td>17–25</td>
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</tbody>
</table>
Risk assessment card

<table>
<thead>
<tr>
<th>Project:</th>
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</thead>
<tbody>
<tr>
<td>Period of project realization:</td>
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<tr>
<td>Filling date:</td>
</tr>
<tr>
<td>Participants:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk event</th>
<th>Probability of occurrence</th>
<th>Consequences on timeframe</th>
<th>Consequences on budget</th>
<th>Consequences on quality</th>
<th>Risk</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Factor</td>
<td></td>
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<td>1.1. ...</td>
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</tbody>
</table>

Note: \( B = \text{Probability of risk event occurrence}, \ C_T = \text{Consequences on timeframe}, \ C_B = \text{Consequences on budget}, \ C_Q = \text{Consequences on quality}, \ R = \text{Risk} \)

Fig. 3. Risk assessment card

<table>
<thead>
<tr>
<th>Degree of risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>Critically risky</td>
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<tr>
<td>Highly risky</td>
</tr>
<tr>
<td>Risky</td>
</tr>
<tr>
<td>Moderately risky</td>
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<tr>
<td>Low risky</td>
</tr>
</tbody>
</table>

Fig. 4. Project classification

At this stage, in order to effectively assess the risk, the following activities are to be carried out:
1. Analyzing each identified risk for the purposes of determining the probability of occurrence;
2. Analyzing each identified risk for the purposes of determining the expected consequences in terms of the preliminary planned project timeframes, budget and quality;
3. Documentation of the results from the risk analysis and assessment.

Risk assessment is not a one-time action. It is to be conducted periodically during the progress of performance of the activities, incorporated in the project. The values of the identified risk events are most frequently determined using: past experience – records, documents, statistics; expert knowledge and valuations.

Stage 3: Development of a risk management plan

The goal of the risk management plan is to develop in advance measures that are specific to each risk event, aiming reduction of the risk to the set acceptable levels. For the development of these measures, additional joint work and cooperation with specialists and experts may be required. The counteractive measures could be focused on reducing the probability of occurrence of the risk and/or on limiting the scope of the expected consequences. The final product of this stage is the development of a risk management plan. (see Fig. 5).

Risk Management Plan

<table>
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<th>Project:</th>
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<tbody>
<tr>
<td>Period of project realization:</td>
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<tr>
<td>Filling date:</td>
</tr>
<tr>
<td>Participants:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Identified risk event</th>
<th>Classification</th>
<th>Required measures for management and control of the identified risk events</th>
<th>Roles, rights, responsibilities</th>
<th>Additional resources for risk management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Factor</td>
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<td>1.1.</td>
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<tr>
<td>2. Factor</td>
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<td>2.1.</td>
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</table>

Fig. 5. Risk Management Plan
The development of a risk management plan comprises the following activities:
1. Accurate defining of the counteraction measures;
2. Selection of the participants in the process – roles, rights, responsibilities;
3. Planning additional resources for risk management.

The action plan must be realistic and the basic requirements for the risk counteractive measures are that they are effective and efficient. For the development of these measures, additional joint work and cooperation with specialists and experts may be required.

Stage 4: Monitoring and follow-up of the risk management process

Monitoring and follow-up of the risk management process is realized by continuous and systematic supervision of the risks and reporting on their status, the purpose being to keep track of how successfully risks are being managed.

The identified risks could change under the influence of different external and internal for the project factors. Therefore, continuous supervision and regular review of the activities related to project risk management is of primary importance. The regularity of control supervision depends on the degree, scope and duration of the project. For the purposes of effective follow-up of the risk management process and taking timely measures, summary of the control observations at the end of each different activity, incorporated in the project, is required.

Effective follow-up of the risk management process involves the following activities:
- Introduction of an internal reporting procedure for identification of the risks, in adherence to the requirements for timeliness, regularity and thoroughness;
- Review, analysis and documentation of the status of the identified risks on a regular basis.

All newly arising problems and changes as a result of the changes in environment are to be entered in the Adjusted Risk Management Plan card (see Fig. 6). It is advisable to get the information from this card visualized on a notice-board, made visible and accessible to all participants in the project.

The responsibilities for effective follow-up of the risk management process are distributed as follows:
- The project manager is in charge of the risk management; he endorses the risk management rules and reports to the superior bodies within the set deadlines and in case of occurrence of critical risks;
- Project team members – they take part in the risk management processes by applying certain control procedures, adhering to the set rules and timely informing the project manager about any occurred problems and found violations;
- For bigger and more complex projects, appointment of a Project Risk Coordinator is advisable, who is in charge of filling and announcing the risk register, keeps documental reports on risk management, provides updated information to the project manager on the risk register and the plan for realization of control activities in project risk management.

<table>
<thead>
<tr>
<th>Adjusted Risk Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of problem arising</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Problem registration</td>
</tr>
</tbody>
</table>

Problem Status Key

- Problem registration
- Problem is accepted and actions for its elimination
- Actions for problem solving are taken
- Problem is solved
- Stage of standardization and support

Stage 5: Summary of the accumulated experience

The last stage of the project risk management process comprises an analysis and summary of the accumulated experience and identification of the good practices. The main goal of this stage is development of a final report to document the complete information on project risk management, which will be useful not only to the project manager, team members and interested participants, but also to any future managers, who could use the gathered information while planning their future projects.

The final product of this stage is the development of a report, containing a summary of the accumulated experience (see Fig. 7).
VI. REQUIREMENTS TO PROJECT MANAGERS FOR EFFECTIVE PROJECT RISK MANAGEMENT

The main requirements that should be met by project managers in project risk management are:
- Project managers should treat risk management as a priority process. They should pay special attention to the factors that represent a drawback to achieving the project goals and take the required actions.
- A key factor to effective project risk management is the understanding and commitment to this process of both the project manager and the project team members.
- A main precondition for effective project risk management is setting up clear objectives. Each objective should meet the following criteria: specific, measurable, achievable, realistic and time-bound. (SMART technology for setting objectives). The proper formulation of the project objectives is decisive for the concrete risk identification.
- Project objectives should be understood by all project team members, which will ensure their achievement by realizing particular actions and tasks.
- The complete project risk management process (decisions made and actions taken for management of the identified risks) should be documented.
- Project managers should ensure regular review of the complete process for the purposes of its timely and proper updating.
- Before application, the presented project risk management model should be adjusted to the specifics of the particular project.

VII. CONCLUSION

Due to its complexity, project realization can often face unexpected problems that lead to falling behind deadlines, exceeding budgets and even development of a product below the level of the set standards. Although these problems cannot be fully eliminated, they can be controlled by the application of risk management methods, which could help for solving the problems before they arise.

The organizations that apply procedures and techniques for risk management have greater control on the overall project management and considerably increase their chances of achieving the project objectives within the limits of the provided resources, budgets and set deadlines.

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The Chinese “One Belt, One Road” Initiative – new opportunities for the European Union and its neighbours in the Black Sea region

Georgi Georgiev

Abstract The Chinese “One Belt, One Road” Initiative offers good opportunities for economic development and security to the Eurasian counties. The project is on a large scale and bases on a solid economic, but also political foundation. Part of the routes lead through the difficult to define Black Sea region. If the EU succeeds to coordinate the policies of its Black Sea member-states, it would be able to benefit from the participation in the project.

Index Terms: Black Sea region, “One Belt, One Road” Initiative, trade routes, Chinese export to the EU, Eurasian corridors, Maritime Silk road

JEL: F15, F35.

I. CONCEPTUALIZING THE BLACK SEA REGION

The first problem that emerges in the case of the Black Sea region is related to its definition. The term “region” has no standard definition – there are many different, if not opposing, point of view and interpretations. The problem of defining this region is extremely complex.1

Regarding its geography, the Black Sea region is a distinct geographical area rich in natural resources, strategically located at the crossroads of Europe, Central Asia and the Middle East. In terms of geography, the Black Sea region is a bridge of huge importance between the Euro-Atlantic community and the strategic zone of the Middle-East - Caspian Sea - Central Asia.

If common history and geographic proximity is considered, we should include all the countries along the Black sea coast: Turkey, Bulgaria, Romania, Ukraine, Russia and Georgia. Moldavia should be included too – formally the country is landlocked, but the river Dnijester enables it a limited access to the Black Sea.

At the same time, however, the geopolitical point of view requires the Black Sea region to be described as a “natural geopolitical center” or a new “geopolitical pivot”. It belongs to an important and sensitive area - with huge natural resources (raw material and energy) and major strategic transport roads and crossroads. This geopolitical importance of the region involves both neighboring countries (such as Armenia or Poland) and more remote (such as Germany) or even non-Eurasian (the USA) countries. Being part of the chain “China – Central Asia – Europe” the Black Sea region is described by Zbigniew Brzezinski as the gate to the “Eurasian Balkans” – an area to be controlled in order to prevent an opposed to the USA consolidation of the Eurasian powers with their resources.2

Regarding its own history, the region is known by various conflicts, whereby old tensions are able to undermine contemporary attempts to launch peace and security. Divided by conflicts, blockades and trade restrictions and characterized by complex causal relationships and correlations, one of the results so far is the absence of any strong institutional set-up.

Combining the interests of such states as Armenia and Azerbaijan, Russia and Georgia, Turkey and Armenia is a very difficult task and shows the limits to encouraging regional cooperation. The task becomes more difficult if external forces, incl. other states, international organizations and multinationals companies would interfere.

The official definition of the European Union, i.e. of the European parliament3, doesn’t pay much attention of these geopolitical considerations, but it adds Greece into the list instead. The still disputed oil pipeline “Bourgas – Alexandropolis” would be able to connect the country with the wide regional transportation set. This definition of the European Union appears first in 2007, as part of the “Black Sea synergy” program. The concept of the “extended (or wider) Black Sea region” should include also the whole region of the South Caucasus to the Caspian Sea.

Launching the concept of the “wider Black Sea region” the Organization of the Black Sea Economic Cooperation (BSEC) tries to prevent a geopolitical division between Western Europe and the Black Sea countries in the East. One can suppose, that this concept reflects also the desire of powerful external players to gain control over vital trade roads there, raw materials and energy supplies etc.

II. REVITALIZING THE TRADE ROADS - THE “ONE BELT, ONE ROAD” INITIATIVE

The economic ties still depend heavily on geography but their use as criterion for defining the region requires not only showing the amounts of wares and services traded, but also analyzing the directions and structure of trade and investment and henceforth the interdependence of the economies involved.

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From this point of view the Black Sea region could be defined as important transportation crossroad, connecting huge producers, suppliers and consumers of raw materials, goods and energy. In this prospectus the importance of Black Sea region is undisputed long before the economic conjuncture raises the importance of the heavily discussed gas and oil deliveries. Its most important role is the already mentioned trade connection between Asia and Europe, namely the famous Silk Road.

Commercial traffic between Europe and Asia along the Silk Road dates from the 2nd millennium BCE.

The rapid economic growth of China and other Asian countries during the last several decades revitalized the trade between West and East and gave a new meaning to the use of the so called Eurasian Land Bridge, the land transport route for moving freight and passengers overland from the Far East China to trade centers and seaports in Europe. Estimating the huge potential of the Eurasian Land Bridge several countries and international organizations launched recently their visions of the further development of the now existing transportation corridors. TRACECA, the international transport program, proposed by the EU in 1993 to link the Union through the Caucasus with Central Asia, was followed by similar incentives for regional development of the United Nations (2000 and 2005).

The United States in their turn are promoting the New Silk Road initiative for Central Asia and Afghanistan, aimed to integrate the region and boost its potential as a transit area between Europe and East Asia. Russia, Turkey and Kazakhstan develop their own projects, all of them involving EU neighbors and partners.

The most advanced of all that projects though proves to be the Chinese “One Belt, One Road” Initiative (abbreviated OBOR), also known as the “Belt and Road Initiative” or simply the “Silk Road 2.0”. OBOR is a development strategy and framework, proposed by the president of China Xi Jinping on a visit to Kazakhstan in 2013. The project focuses on connectivity and cooperation among countries in Eurasia, with two main components - the land-based "Silk Road Economic Belt" (SREB) and the "Maritime Silk Road" (MSR). (See figure 2) It aims at raising the efficiency of the logistic net, linking China with the huge European market, to reduce the dependence on the maritime trade roads (guarded primarily by the US Navy) and to secure the sources of raw materials and energy in Central Asia. If successful, the strategy should raise China's role in the global affairs.

To the countries involved it offers sharing the extra benefits of the enhanced economic ties with the West. The Silk Road Economic Belt initiative includes several countries situated on the original Silk Road routes through Central Asia, the Middle East, and the Black Sea region. (See map.) The initiative envisages the integration of a cohesive economic area through building infrastructure, broadening trade and setting a new specialization in the international division of labor. Apart from the zone of the historical Silk Road, an extension of this “Belt” to South Asia is also foreseen.

Serving primarily the Chinese interests, the project is based on the formidable economic performance of China. Its socialist market economy is the world's second largest economy by nominal GDP, and the world's largest economy by purchasing power parity according to the IMF. It is also the world's fastest-growing major economy, with growth rates averaging 10% over the past 30 years. Now China is a global hub for manufacturing, and is the largest manufacturing economy in the world as well as the largest exporter of goods in the world, exporting almost every single category of industrial products. Due to the raising living standard the country becomes the world's fastest growing consumer market and second largest importer of goods. China is the largest trading nation in the world and plays a vital role in international trade, being a member of the World Trade Organization since 2001. It also has free trade agreements with several nations, including Australia, South Korea, Switzerland, Iceland and Pakistan. Following the export oriented economic model, China is heavily dependent on open foreign sales markets, but also (due to its geography) on abundant and secure raw materials and energy supplies.

![Figure 1: Main routes of the Silk Road](https://en.wikipedia.org/wiki/Silk_Road)

Source: [https://en.wikipedia.org/wiki/Silk_Road](https://en.wikipedia.org/wiki/Silk_Road)
China has no free trade agreement with the European Union. Nevertheless, the European Union and China are two of the biggest traders in the world. China is the EU's 2nd trading partner behind the United States and the EU is China's biggest trading partner. China is one of the EU's fastest growing export markets, while the EU becomes China's biggest source of imports. China and Europe now trade well over €1 billion a day. The EU records a significant trade deficit with China, but this is about to change with the raising domestic demand in China, incl. for more expensive consumer good of high quality, offered by the EU. The Chinese export to the EU reached € 279.9 billion in 2013. 80% of the exported goods reached the European market by sea through the ports of Antwerp, Rotterdam, Hamburg and London. Negotiations with the EU are on the way to regulate the bilateral investment and, possibly, the problem with the trade barriers.

III. CHINA’S EURASIAN CORRIDORS AND THE BLACK SEA

China’s attempt to develop its transport and communication capabilities through Central Asia to Europe is promoted through the construction of railway, highway, aviation, telecommunications, and electricity networks. (See figure 3.)

A railway from China to Europe, the New Eurasia Land Bridge or the Northern Eurasian corridor, is already operational. It starts at the Chinese port of Lianyungang, and then passes through Kazakhstan, Russia, Belarus (using partly the old, inherited from the former USSR and even from the Russian empire infrastructure), Poland, and Germany, and ends at the Dutch port of Rotterdam. Another similar route, a transcontinental railroad, the Trans-Siberian Railway, runs via Northeastern China and Mongolia through Russia in the same direction. Being fully electrified and double-tracked line, the Trans-Siberian Railway is capable of transporting around 100 million tons of freight annually. The line can handle up to 200,000 TEU of containerized international transit freight per year.

As of November 2007, about 1% of the $600 billion in goods shipped from Asia to Europe each year were delivered by inland transport routes. Developing the network should help to raise this share considerably. The 10,900 km long line has been extended in 2008 with other existing railway network to establish the “Chongqing-Xinjiang-Europe” trade channel, originating in Chongqing and ending at Duisburg, Germany. The trains, operated by DB Schenker (Germany), cover 10,800 km within 14 days, three times weekly, carrying up to 50 40-foot-long containers.

More interesting for the Black Sea region is the land route through Central Asia, along with the “Maritime Silk Road”. The so called “New Eurasian Land Bridge” or the “New Eurasian Continental Bridge”) should link China on land with Central Asia, reaching further Europe across the Bosphorus through the Marmaray link. (See figure 4.)

The planned route includes China’s east-west railways which continue to Kazakhstan, Uzbekistan and ends at Türkménbasy, Turkmenistan, a port on the Caspian Sea. A branch railway across the Turkmenistan’s border with Iran, established in 1996, enables the access to the ports on the Persian Gulf, but also alternative routes to the Caucasus and Turkey, bypassing so the Caspian Sea. Crucial for completing the whole route from Lianyungang to Rotterdam (a distance of 11,870 kilometers) is the opening of the Bosphorus tunnel (“Marmaray”) in October 2013. The map illustrates that the inland Silk Road begins in Xi’an.
Then it runs to the west via Lanzhou, Urumqi, and Khorgas before swinging to the southwest and continuing through all five countries of Central Asia, the Middle East, and Turkey. From Istanbul, the Silk Road crosses the Bosphorus Strait and heads northwest across Europe, including Bulgaria, Romania, the Czech Republic, and Germany. Reaching Duisburg in Germany, it swings north to Rotterdam in the Netherlands. Having reached Istanbul however, the route comes closer also to the Mediterranean harbors of the European Union to meet the Maritime Silk Road.

Due to longer distance, bad infrastructure and border crossings, this route has not been used for transports from China to Europe till now. But the “OBOR” incentive foresees investments for improving infrastructure and raising efficiency and the route should be given high priority. Since 2010 Turkey is working hard on completing the whole high speed railroad from Edirne to Kars (at the Georgian border). The distance of 1500 km must be covered within 8 hours. The $ 35 billion project also relies on Chinese assistance, both on financing and on delivering technology. In November 2014 the Chinese Ministry of Railway Transport announced, that it would guarantee the transportation of 10 million tons of cargo annually via the Baku-Tbilisi-Kars railway.

So far the Marmaray tunnel has its limits for freight trains due to dense public transport via tunnel and security concerns (dangerous goods for instance). The completion of the entire project (after 2016?) should extend its capacity, but there are alternative projects too. These alternatives should rather complement this route, instead of competing with it.
2,089,000 tons to 3,873,000 tons. There are 13 vessels with wagon capacities up to 54 railcar units, operating on the Caspian between Baku, Aktau and Turkmenbashi.  

The Black Sea transportation network is still lagging behind. The ferry lines, linking the main Black Sea harbors (Constanta, Varna, Istanbul, Poti, Ilyichevsk) are feeble and still lacking economic perspectives. The war in the Ukraine worsens the situation considerably. The Chinese government examined in 2013 the possibility of building on the Crimea a large logistic center, including a deep waters port, stores, railway station etc. at the amount of $ 3 billion. The ongoing war discomfits so far these plans. (On the other hand, these plans could provoke Chinese efforts of mutual benefit to settle things into shape too. The crisis there is far from over, but the advantages of the peninsula are not to be neglected.) In addition to the ferries, a high-speed railroad, linking Bucharest with Chisinau (and Kyiv) is taken into consideration, once again relying on Chinese capital and technologies. Prolonging the line along the northern Black Sea coast to the Russian and Georgian transportation networks would complete the whole Black Sea transportation ring as a key section of the “New Eurasian Land Bridge”. Once again, it requires peace and stability in the Ukraine, but not only there.

The missing section of the emerging Eurasian railway network (the so called “Iron Silk Road”) is the much delayed Baku-Tbilisi-Kars railway (826 kilometers), to enter service after 2017. Turkey closed in 1993 its border with Armenia to support Azerbaijan after the Nagorno-Karabakh War, cutting off the existing Kars–Gyumri–Tbilisi railway line. This line remained unused due to the bad relations between Azerbaijan and Armenia following the Nagorno-Karabakh War. Azerbaijan, Turkey and Georgia launched the project mentioned instead. Lack of funding, the Russian-Georgian-Ossetian conflict (2008) and environmental problems delayed the project, planned to reach a capacity of 3 million passengers and over 15 million tons of freight. In total 105 kilometers of new line should be built between Kars and Akhalkalaki, and the existing railway should be modernized. The openly announced intention to bypass Armenia (“...until Armenia liberates the occupied Azerbaijani territories, all transportation projects will bypass [this] country”, Azerbaijani President Ilham Aliyev) provoke the opposition of the latter, relying on its lobbies in Washington and the West European capitals in order to hinder the undertaking. Once again, China (with its immense financial capacity and neutral political position) could help diminishing the tensions in the region to build a regional transportation network of complementary lines of mutual benefit.

IV. ECONOMIC AND POLITICAL CONSIDERATIONS

There is always difficult to separate politics from economics. “OBOR” is both geopolitical and geo-economic project, so economic and political considerations should be linked together. As mentioned, about 1% of the $ 600 billion in goods shipped from Asia to Europe each year are being delivered by inland transport routes. This is not a significant amount. Due to the bad infrastructure the transportation costs and capacity of the land routes cannot match to these of the maritime routes. But the intention is not to avoid the latter; the role of the land routes is to complement them and to open new opportunities. Clever investment should rise capacity and reduce costs, while the anyway higher speed should rise considerably. Crucial here is the slow shift of the Chinese industry westwards to the heartland. (See figure 6.)

This shift of the Chinese industry westwards prolongs the trip to the European harbors up to 60 days. For expensive but small articles of higher demand on competitive markets (for instance electronics) this delay might be unacceptable. As mentioned above, the trains, operated by DB Schenker (Germany), cover the distance of 10 800 km between Chóngqing to Duisburg in 14 days. Modernizing the line in Kazakhstan must reduce the trip to 10 days. After opening the Korgas railway the amount of standard 2-TEU containers is about to reach 10 000 per annum.

It is not too much in comparison with a single “Maersk Triple E class” container ship (carrying up to 18 270 TEU), but on the other hand a Boeing 747-8 Freighter is able to carry the equivalent of 4 to 5 TEU containers or more than 500 000 pieces of smartphones.

This is less than 5% of the capacity of a single train. On sea the transportation of a single TEU container costs $ 4000, while the railroad operators require $ 9 000. New technologies are about to reduce this cost to less than $ 5 000, while raising demand for European luxury articles in China should help to minimize the amount of empty containers, travelling back. It becomes obvious, that the transportation of goods on land has its serious economic foundation. The revival of the traditional and historic trade route between Asia and Europe (via Turkey) could lead to a $ 75 billion trade flow per annum.

This should be taken into consideration. But the success of these long-term projects is linked also with the success of the Eurasian Union, established on 01.01.2015 r. According to the same source, after lifting the custom barriers on its territory, the number of briberies and protraction diminished sharply, the treatment of cargo accelerated and the time for travel has been shortened by 3 to 4 days.11

This capacity of this line alone might sounds overestimated, but the entire “OBOR” network, including the Maritime Silk Road route, will be able to change the map of the world economy. The choice among several routes will depend on both economic and political considerations. Redirecting a large amount of the cargo from the World Ocean (controlled by the US Navy) to land routes beyond US military control will diminish the vulnerability of the Chinese trade in case of confrontation with the USA. (Many US politicians are convinced of the inevitability of this confrontation. See Joseph Santolan, 2015.)

The shipping on the Maritime Silk route is focused on shortening the line – through the newly widened Suez channel to the Greek sea ports. (See figure 2.) Shortening the line foresees a transport corridor via Myanmar, India, and Bangladesh through which China should get access to the Indian Ocean, bypassing the Strait of Malacca and the tensions in the South China Sea. Helping Pakistan to build a deep-sea port at Gwadar, China plans to strengthen the communications with South Asia and the Persian Gulf, including attempts to ensure oil deliveries from the Middle East through this port to Xinjiang. The southern direction is also an important component of the Silk Road strategy and requires solving the long standing problems within the triangle “China – India – Pakistan”.

Solving these problems might accompany crucial geopolitical and economic changes, provoked by the attempts of the BRICS-countries to gain better positions in the world economy and to diminish their dependence of the US-dominated financial institutions.

The announced on November 9, 2014, by the Chinese leader Xi Jinping “Silk Road fund” of $ 40 billion is planned to “drive investment in infrastructure, and speed industrial and financial cooperation in Central and South Asia.”13 As a fund, its role will be to invest direct in the infrastructure projects. Management of the project is ensured by very high Chinese functionaries, the so called Leading Group for Advancing the Development of One Belt One Road, reporting directly into the State Council of the Republic.

This move complements the newly established “Asian Infrastructure Investment Bank (AIIB)”, initiated and led by China, with the participation of 56 other countries. This bank of $ 100 billion includes also 20 Asian countries, among them Russia, Kazakhstan and Uzbekistan. It is expected to foster the economic development of countries, not able or not willing to meet the requirement of the World Bank and the International Monetary Fund. Interesting enough, West European countries (both EU and NATO members, such as Great Britain) engaged in the undertaking, despite the objections of the USA. Obviously there are huge expectations, related to the economic potential of (Central) Asia, and the European Union shouldn’t miss the new arising opportunities.

In summary: China is both able and interested to invest heavily in developing its trade infrastructure, primarily focused on the EU, its important trading partner. Chinas intentions to invest in European infrastructure have been confirmed during the meeting between the Chinese Prime minister Li Keqiang and the president of the European Commission Jean-Claude Juncker in June, 2015. Becoming mediator between the European Union and Japan, South Korea and other Asian developed economies, is another reason for launching the initiative mentioned. Gaining access to the raw material and the energy needed (according to the “Marching Westwards” strategy) is one more consideration to be taken into account. The EU neighboring countries in the Black Sea region are also involved, as envisaged in the variants of the “OBOR”.

Figure 7: Foreign exchange reserves of major economies

Source: http://rt.com/business/221659-china-4-trillion-reserves


V. THE MARITIME SILK ROAD AND THE WIDER BLACK SEA REGION

As shown on the map (figure 2), the planned logistical net, linking China with Europe, involves also countries of the wider Black Sea region. The Chinese intentions are presented in the „Central and Eastern Europe in Building the Silk Road Economic Belt“14, issued by the Chinese Academy of Social Sciences. In 2014 r. started building and renovating the railway infrastructure in Albania, Bosnia and Herzegovina, Macedonia, Serbia and Montenegro. The assistance includes financing, but also newest Chinese technologies. (Thanks to the cooperation with “Siemens”, “Alstom”, “Kawasaki Heavy Industries” and “Bombardier” the Chinese enterprises developed their own high speed trains and whole logistic systems.) These Chinese activities are welcome there, while the European Union lacks resources (maybe also political will) to support the countries in the region during the ongoing financial crisis.

The so called “Western Balkans” face vague prospects for EU-membership, but take the advantages of the free trade with the Union (so far the Chinese investors don’t need to respect the European rules for public orders there), offering at the same time direct transportation access to its core. Their inclusion into the “OBOR” initiative depends both on their activity and their ability to conform the requirements of the possible membership and their national interests. If successful, they could become part of the value adding chain (production, marketing, distribution) along the trade route between China and Europe, which is in fact the essence of the “OBOR”. The outlines of the route are already visible. The prolongation of the Maritime Silk road envisages a high speed railroad of considerable capacity between the Greek harbors (Piraeus) and Budapest (foreseen as a large transportation hub).

![Map](http://e-distance.com/Piraeus/Budapest)

Figure 8: The route „Piraeus – Budapest“

Source: http://e-distance.com/Piraeus/Budapest

Greece has been chosen as a fulcrum. Its harbors are the closest to the renewed Suez Channel. Its merchant fleet is the largest in the world (16.2 % of all vessels) and delivers 60 % of the Chinese raw materials and energy imports.15 In its turn, this fleet is the largest customer of the Chinese shipbuilders. Chinese capital could help Greece to overcome the current financial crisis – COSCO offered in 2009 r. almost € 5 billion for a 35-years partial concession of Piraeus harbor. According to the plans the high speed connection must shorten the travel of the Chinese cargo from 24 to 17 days.

Unlike the Western Balkans, Bulgaria and Romania prefer more on the Eurasian Corridors, mentioned above. Several important trade routes cross the Balkan Peninsula. The Pan-European transport corridor №4 (the ancient “Via militaris”) is the shortest connection between Central Europe and Istanbul. The Russe-Varna route links the Pan-European transport corridor №7 (the Danube River) with the black Sea with its ferry lines. Corridor №8 (Burgas - Durres) links the Black Sea with the Adriatic Sea and Italy, the fourth largest economy of the European Union. The countries of the region are not keen to cooperate and to persuade their neighbors for launching common projects though. Lack of resources and of a common European conception on the subject makes things worse. There is a counterproductive competition among the countries concerned. Romania tries to redirect corridors №4 and 7 to the port of Constanza with its large capacity (larger than the capacity of Burgas and Varna together), while Serbia postpones for years the completion of the high speed connection between Belgrade and Sofia, preferring the “Piraeus – Belgrade – Budapest” link instead. Mismanagement of priorities and of public resources (incl. from European funds) leaves the infrastructure of Bulgaria (ports, railroads, railroad-operator etc.) in a bad condition. The link “Burgas – Durres” seems abandoned in favor of the newly finished “Via Ignatia” on Greek territory.

Due to this competition the countries in the region try separately to gain control over each possible trade route, instead of formulating their common interests and coordinating their policies, both with China and other interested EU-members.

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14 „US threatens military confrontation with China in South China Sea“, https://www.wsws.org/en/articles/2015/05/14/scse-m14.html
15 http://www.whuced.com/show/?id=165&siteid=3
“OBOR” is a long term, large scale project. It should stimulate the trade between China and Europe in both directions and to support the wholesale economic development of the countries involved. Among them are also EU-members of the wider Black Sea region. The European Union should consider its own interests and formulate a common policy (incl. goals, kind of participating, financing, etc.) and to cooperate with China and the countries along the routes proposed. This cooperation both requires and could contribute for settling down local conflicts in the Black Sea region, in the Caucasus or in Central Asia. Focusing on running, though acute, problems, such as the euro-crisis or the refugees from Syria, should not divert the attention from opportunities of strategic importance.
NATO and EU in the context of Energy security and Global commons
(The situation in Ukraine - a case study for the Black sea region)

Monika Panayotova

Abstract This article aims at focusing on the complex character of security threats and challenges and the need of NATO and especially EU strategic documents' modernization in the field of security and defense. The main accents are given to the Energy security and Global commons which have strategic importance with economic and military impact. Those issues reveal the global interdependence between countries from the access to viable resources as well as the level of Europe's dependence on Russia energy supply, keeping in mind that 22/28 EU Member states are also NATO members. The situation in Ukraine is presented as a case study for the countries from the wider Black sea region, relying also on the experience with Georgia and generating conclusions about the Euro-Atlantic integration in the Region, the frozen conflicts, which could be perceived as a buffer zone between Russia and Europe and the strategic approach needed from EU and NATO in the context of the Black sea geopolitical dynamic.

Index Terms: CSDP, NATO, Ukraine, wider Black sea, energy security, global commons, strategy, frozen conflicts, globalization, security threats and challenges.
JEL: F15, F35.

I. INTRODUCTION

The energy security and global commons are related to the complex character of security threats, comprising: climate change, competition for access to resources and the necessity to adequate response to the challenges of globalization. For this reason in time of strategic rethinking and globalized world NATO and EU should pay attention to those topics.

In 21st century due to the high competition for access of EU, NATO and other international players to key resources, mainly oil, natural gas and global commons, as well as to the free water, air and ground transportation, the security and defense issues acquire strategic importance and accumulate higher expectations about their solution.

The crisis in Ukraine, provoked by the Russian military intervention and the annexation of Crimea, marks the beginning of a new confrontation and a pressure over Black sea countries in the context of a battle for geostrategic advantages and control of energy resources' providers, oil and natural gas transportation corridors as well as over the ground, maritime and air transport.

The increasing need of energy supply diversification and of lower energy dependence from Russia, make the wider Black sea region an important strategic energy corridor, a cross point of Roads, coming from North to the South and from East to the West. The main oil and natural gas projects describe in a clear manner the geopolitical dynamics of the interests in the Region. For this reason the energy diversification represents an attempt for the strategic balance achievement.

II. NATO AND EU - ENERGY SECURITY AND ITS STRATEGIC IMPORTANCE

From EU point of view

The Energy resources were into the heart of European integration. Today they represent a test for the EU geopolitical positioning, taking into consideration the low levels of resource availability and the need of energy supply diversification. In 1950, Robert Schuman declared that he wants to create 'solidarity' between countries in strategic industries for the production of coal and steel, making war in Europe 'makewarnot only unthinkable but materially impossible'.

If we should shortly describe the current situation, we will have the following picture: today there is a European Security Strategy, created 12 years ago and updated in 2008, followed by three enlargements of the Community with 8 new Member States, five years after the adoption of the Lisbon Treaty, which created a new legal framework and overall restructuring of the common foreign and the common security and defense policy.

The new global threats, challenges and insecurity in a more dependent world as well as the concrete realities in immediate geographical proximity to EU borders shall be taken into consideration, in the context of the needed modernization of European security strategy. If Europe wants to play a key role in shaping the future global order, the creation of a comprehensive EU strategic document in the field of security and defense has an incremental role. It should include specific themes as the energy security and global commons, which have economic and military dimension and impact.

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The high degree of interdependence among Member States, due to the policy of integration, of economic and social cohesion, of interconnected infrastructure in transport, energy, information technology and other areas suggests managing the processes before taking appropriate decisions, which is associated with higher degree of confidence, a close contact and exchange of information and agreement on strategic priorities in different sectors. In this regard, a potential initiation of European defense semester to be coordinated by the European Defense Agency, similar to the one associated with the new EU economic governance, would be an important moment in the definition and fulfillment of the EU level of ambition.

Keeping in mind that 22/28 EU Member states are also NATO members and that they share the same theatre of operations, if we have to describe in numbers the current situation in the field of energy, we will have the following results: in 2014 EU imports 53% of the energy it consumes. The costs for energy supply for EU amount more than 1 billion euro per day or 400 billion per year, which represents more than 1/5 from the whole EU imports. The dependence of Europe is clear as the Union “imports almost 90% of its crude oil, 66% of its natural gas, 42% of its solid fuels such as coal and 40% of its nuclear fuel. The energy security concerns all member states, but the most sensitive and dependent are the Baltic countries and Eastern Europe.” In six EU Member states, Russia is the only external supplier for their entire gas imports and three of them use natural gas for more than a quarter of their total energy needs. In 2013 energy supplies from Russia accounted for 39% of EU natural gas imports or 27% of EU gas consumption; Russia exported 71% of its gas to Europe. “70% of the whole Russian export is related to the natural gas and oil exportation. At the same time the energy demand worldwide is expected to increase by 27% by 2030 with important changes to energy supply and trade flows. The EU is expected to rely on natural gas imports which amount will increase from 66% today to 80% in 2030.

The importance of the energy security issues for the EU is demonstrated with the adoption of the European Energy Security Strategy. In 2009 the Third Energy Package was adopted, focusing on the liberalisation of energy markets in the Member States and unbundling the operation of gas pipelines and electricity networks from the business of providing gas or generating power.

In this way large companies will not be allowed to produce energy and at the same time to own the energy networks. The objectives of the new law package are to guarantee: the consumers’ choice, investments and security of supply.

The Strategy sets out areas where decisions need to be taken or concrete actions implemented in the short, medium and longer term to respond to energy security concerns. It is based on eight key pillars that together promote closer cooperation beneficial for all Member States while respecting national energy choices, and are underpinned by the principle of solidarity: 1. Immediate actions aimed at increasing the EU’s capacity to overcome a major disruption during the winter 2014/2015; 2. Strengthening emergency/solidarity mechanisms including coordination of risk assessments and contingency plans; and protecting strategic infrastructure; 3. Moderating energy demand; 4. Building a well-functioning and fully integrated internal market; 5. Increasing energy production in the European Union; 6. Further developing energy technologies; 7. Diversifying external supplies and related infrastructure; 8. Improving coordination of national energy policies and speaking with one voice in external energy policy.

In summary the Strategy, presented in May 2014 by the European Commission, proposes diversification of energy resources and supply, decrease of energy consumption, investments in renewable energy resources and reinforcement of cooperation between the countries.

In the context of energy security and global commons shall be taken into account a key moment in NATO’s strategic concept revealing that “Some NATO countries will become more dependent on foreign energy suppliers and in some cases, on foreign energy supply and distribution networks for their energy needs. As a larger share of world consumption is transported across the globe, energy supplies are increasingly exposed to disruption.

From NATO point of view

The energy security issues become more and more significant in the common security debate, attracting the attention of NATO due to certain factors: Europe’s growing dependency on oil and gas; the growing energy needs of rising powers such as China and India; the depletion of fossil fuels expected to set in after the middle of this century; an intensifying debate on climate change; and a renewed interest of many nations in civilian nuclear energy.

Additional factors include armed threats to energy supplies, be they through terrorist attacks or piracy, and the political instability in many energy-producing states – including attempts by some of these states to (ab)use energy supplies as a political weapon.

Turkey, Greece, Bulgaria and Romania are NATO member states, Azerbaijan, Armenia, Georgia and Moldova are members of NATO initiative Partnership for Peace. The membership and relations of those countries to NATO, attract the attention of the North Atlantic Alliance to the instability, threats and challenges in front of the Black sea region and energy security in particular.

NATO and EU have 22 common member states. Frequently their way of perceiving energy security as a national problem, a problem of their national economies represents one of the big challenges in front of the both organizations. It’s difficult for member states to surrender their sovereignty in the field of energy. In spite of the European Commission’ calls for the member states to speak with “one voice” on energy issues, to have a better coordination and Common European geopolitical and economic vision in order to decrease the level of energy
dependence from external suppliers, the countries prefer to conduct bilateral relations and to sign bilateral contracts. Given the complex character of security risks and threats in the globalized world, it’s typical for them that none is purely military and/or can be addressed though purely military means.

In this regard it can be noticed that the energy security influences more and more the whole European security. In spite of the fact that frequently energy security is observed from national, economic, infrastructural and European point of view, it is also part of the NATO focus.

The energy security became a subject of NATO observations due to the confrontation between Russia and Belarus in 2005 and between Russia and Ukraine in 2006 and 2009, which respectively provoked the suspension of oil and gas delivery to Europe. The interest in the field of the North Atlantic Alliance gradually increased and it was a subject to discussion during the NATO Summits in Riga 2006, in Bucharest 2008, in Strasbourg – Kehl 2009, in Lisbon 2010, in Chicago in 2012 and in Wales 2014.

If we should summarize the main points, which coincidence in the most of Summit declarations and the NATO’s strategic concept, we could conclude that the role of the Alliance in the field of energy security is related to the following challenges and sphere of action:

Challenges which shape the future security environment in the field of NATO interests:

- the increase of energy demands and a larger share of world energy consumption;
- the increase of some NATO member states’ dependency from external energy suppliers, in some cases, from foreign energy supply and distribution networks for their energy needs;
- the suspension of energy supply from Russia (oil and gas);
- the need of a guarantee of vital communication, transport and transit routes on which international trade, energy security and prosperity depend;
- the need of stability of energy supply and of interconnection of the energy distribution networks;
- the need of diversification of routes, suppliers and energy resources.

NATO’s sphere of action in the context of energy security:

- to consult on the most immediate risks in the field of energy security;
- to share information and intelligence fusion;
- to further develop the NATO information activities;
- to project stability;
- to develop the capacity, to support and protect the critical energy infrastructure, transit zones and lines;
- to support consequence management of certain risks;
- to work towards significantly improving the energy efficiency of the military;
- to integrate the element of energy security in NATO policies and activities;
- to achieve a progress in international and regional cooperation;
- to cooperate with partners and consult with Allies on the basis of strategic assessments and emergency planning;
- to have NATO added value in energy security field, entirely coordinated with the International community’s efforts, which is characterized by a range of organizations, specialized in energy security;

On the basis of the above mentioned moments related to the energy security in the NATO Summit declarations from Riga /2006/ to Wales /2014/, it could be noticed that the main departure point in the field, containing more concrete information about the added value of the Alliance was initiated during the Bucharest Summit Declaration.

The two key accents of NATO added value in energy security field could be presented as follow:

- Accent on the security of critical infrastructure, especially in transit and energy producing countries as well as on the security of transport corridors and on the analysis of terrorist attacks. In principle this is part of the Members states’ obligations, but NATO could be involved with civil experts and military means in the monitoring of the maritime routes and territorial waters upon a request from the Allie. In addition the NATO department for Civil Emergency planning can help in the cases of natural and/or man-made disasters (for example oil spill);
- Accent on projecting stability, which means first and foremost, shaping the reform processes in NATO’s broader strategic environment. The emphasis is on political dialogue and military cooperation with partner countries in Europe, the Caucasus, Central Asia, the Middle East and the Gulf region. This group comprises energy producers, transit countries and consumers. Consequently, energy security features in many individual cooperation programs.

The North Atlantic Alliance’ activities could be summarized in five main groups:

Fig. 1. The North Atlantic Alliance’ activities
However NATO still mainly acts as a forum for consultations, in a very delicate and cautious manner due to:

- its organisational character (military alliance);
- the nature of energy issues, which have national, economic, infrastructural and political dimension and are part of the activities of national, private and international organisations;
- the bilateral nature of contractual relations in the field;
- the different perceptions about Russia of Central and Eastern Europe countries and those in Western Europe.

In this regard the question about the possible implementation of Art.5 of North Atlantic Treaty in the context of energy security has no clear answer. The energy security is part of the Art. 4 consultations process, except in the cases of a large scale attack on NATO command and control systems or energy networks when art.5 could be mobilized.

At the moment, in the context of security and defense issues in Europe, NATO remains the leading organization, implementing “hard policy” in security area (the Allies depend on art.5). Through its potential to combine civil and military capabilities as well as to operate on territories where NATO couldn’t do it due to political reasons, EU has the opportunity to play an important role and to fulfil the existing vacuum. NATO is a transatlantic military union while EU is a political union of European member states which have the common goal to turn it into a comprehensive actor, deploying a set of instruments for external action, humanitarian aid and civil and military capabilities in the cases of military crisis management.

Having in mind the above mentioned and that the overall restructuring of the common foreign and the common security and defence policy coincides with NATO’s strategic concept, the prerequisites for a sustainable culture of cooperation between NATO and EU became obvious.

Better partnership at global level will ensure better knowledge and awareness of regional conditions, which are crucial to find the most appropriate solutions and responses to the already existing and future security challenges (as it could be the case in the Black Sea).

III. NATO AND EU - THE GLOBAL COMMONS AND THEIR STRATEGIC IMPORTANCE

The global commons are not a new topic, but with the new global threats and challenges, it becomes more actual and relevant. In this regard it should be taken into consideration in the context of strategic documents' modernization in the field of security and defense.

In the contemporary global geopolitical environment no single state could consider that its security depends only on the predisposition of the neighboring countries. The security of every country is closely related to the security of the others, which underlie the collective security organization - UN and its Security Council. In this sense the national and collective defense could not be assured only via border protection of a certain territory, but taking into consideration the capability to project security in global commons.

The so called global commons refers to resource domains or areas that lie outside of the political reach of any one nation State. In this regard the international law determines 4 global domains: High Seas; the Atmosphere; Antarctica; and, Outer Space. Despite efforts by governments or individuals to establish property rights or other forms of control over most natural resources, the Global Commons have remained an exception.

Those domains are not under the control of any one state, but they are open to use from different countries, international organizations and even from individuals. Their regulation is based on the international treaties and agreements and not being under the sovereignty of any country, they could be considered as a linkage in the international system. As it has been already mentioned,

the access to global commons has economic and military dimension and impact. For this reason they are directly connected to the military capabilities for national and collective interest defense, which guarantee the free movement of goods, people, communications and data – a prerequisite for normal functioning of each country, its economy and citizens’ security.

Independently of the end of Cold war and the dominant economic and political tendencies of integration in Europe, the following challenges are still on the agenda: 1/the world is still unstable; 2/there are still aconfrontation, rivalry and crisis in different world regions; 3/the balance-of-power concept is still relevant for some of the developing countries; 4/the principles of democracy and rule of law are still abstract notions for some countries and others use them to legitimize their non- democratic goals and actions.

In this regard given the complex character of security and defense threats, it is needed to have a strategic vision, flexible and pragmatic approach as well as resources availability for guarantying the countries’ prosperity and the security of their citizens.

Part of this strategic vision should be the global commons. The states vulnerability increasing due to: the global warming; the development of technologies, global economy and high level of interdependence; the larger share of world consumption of natural and energy resources and the respective competition in the field; migration, pandemics and non - military character of security challenges.

The domains of High Seas; the Atmosphere; Antarctica; Outer Space and cyber space are interrelated, but each of them dispose with specific characters. For this reason in order to have a full picture they should be observed separately as well as together. Most of the NATO and EU member states have open, global oriented economies, highly dependent respectively on the free access of Global commons.

The indicated sequence from the 4 domains enumeration list reveals the historical consecution of their development and regulatory regimes, which regulate their free use, being guided by the principle of the common heritage of
humankind - the open access doctrine or the mare liberum (free sea for everyone) in the case of the High Seas. In the context of Outer Space and cyber space the international law is very limited.

In the globalized world NATO and EU face the security challenges in the global economic system. In this context, in order to act globally, NATO notes in its xxiii strategic concept that: “All countries are increasingly reliant on the vital communication, transport and transit routes on which international trade, energy security and prosperity depend. They require greater international efforts to ensure their resilience against attack or disruption”. Emphasizing on the need of xxiii strategic rethink in the field of security and defense, followed by new strategic documents of EU and NATO, which to respond to the new realities, it should be noted what the strategic importance of global commons is.

More than ever the defense and economy of EU and NATO member states are highly dependent on the free exchange of information, free movement of people, goods and services in those domains.

In spite of the fact that there is certain justness in the ideas for peace and security about the usage of global commons, it could not be concluded that they are accepted in a same manner from all the players at the international stage, especially from the networks of global and regional terrorists, organized crime groups, involved in smuggling people, drugs, weapons, firearms, munitions as well as the extreme nationalist political organizations.

At the same time there are many nations that didn’t explore and define their interests in the field of free access to global commons. The situation becomes worst due to the global warming which reflects the state of the seas and oceans, respectively the fish catch in international waters and the derivation of natural and energy resources, causing environmental problems.

In the strategic document - Sustaining U.S. Global Leadership: Priorities for 21st Century Defense “, representing a strategic guidance for the future development of American armed forces, notes that: xxiv Global security and prosperity are increasingly dependent on the free flow of goods shipped by air or sea. State and non-state actors pose potential threats to access in the global commons, whether through opposition to existing norms or other anti-access approaches. Both state and non-state actors possess the capability and intent to conduct cyber espionage and, potentially, cyber-attacks on the United States, with possible severe effects on both our military operations and our homeland. Growth in the number of space-faring nations is also leading to an increasingly congested and contested space environment, threatening safety and security. The United States will continue to lead global efforts with capable allies and partners to assure access to and use of the global commons, both by strengthening international norms of responsible behavior and by maintaining relevant and interoperable military capabilities.

xxvi For the past several decades, an overwhelming advantage in technology and resources has given the U.S. military an unmatched ability to project power worldwide. This has allowed it to guarantee U.S. access to the global commons, assure the safety of the homeland, and underwrite security commitments around the globe. U.S. grand strategy assumes that such advantages will continue indefinitely. In fact, they are already starting to disappear.

The current situation is different due to the multipolar world and respective deconcentration of power. The US advantages decrease, because countries such as China, Russia, India, Brazil and others started also intervening in the management of the global commons. In this regard US initiated a process in the framework of NATO of roles, missions and tasks assessment in the field.

The role and responsibilities of EU and NATO concerning the free access to global commons, could be well defined if each domain is individually analyzed, differentiating the separate threats, challenges and recommendations. In the context of a need of an updated or a new EU security strategy, taking into account the global commons management and current realities, the following recommendations should be noted:

1/The navy plays incremental role for conducting joint operations with different character as well as for the pure naval operations. Being a political and military Alliance with a naval history and shared values, NATO has to play a key role in the High seas domain.

Part of NATO member states are one of the oldest nations with traditions in shipping. In this regard NATO shall continue contributing to the practical implementation of the adopted in 1982 UN Convention on the Law of the Sea. Despite of its weaknesses, this convention plays a stabilizing role in the international law, assuring of all countries a free access to the seas and oceans;

2/ Four of the five nations that are making territorial claims to portions of the Arctic (Canada, the United States, Norway, and Denmark) are NATO members. The fifth, Russia, has had special partnership status within NATO since 2002. This may be a further opportunity for NATO to support legal remedies by serving as a place for these nations to broach their interests and concerns about the future of the Arctic. The more Alliance members can cooperate to solve mutual problems, the more NATO can exercise “leadership by attraction,” demonstrating the value of supporting a regime like maritime law, and the benefits of cooperating with like-minded nations to accomplish goals.

The large scale demands resources decreases the opportunities for cooperation while increases the competition as well as the access of competitors to the global commons.

North Continental Shelves in Asia, Europe and North America become more attractive for access due to the global warming, the progress in deep-sea mining techniques, the rise in prices of mineral resources. In addition the behavior of the fifth nation provokes inquiries in the field. In August 2007, the geopolitical and strategic importance of the Arctic region is growing, as symbolized by the planting of a Russian flag on the sea bed below the North Pole.
In this regard the situation in the high North describes the liaison between the global warming, resources deficits, progress in technologies and the security of NATO.

In the context of the need of new or updated strategic documents in the field of security and defense, the Arctic domain should be considered as a potential conflict zone, which could be neutralized by the principles of cooperation, mutual problem and claims solving, respecting the international law.

3/ The more the Alliances coordinate their efforts to control the Air traffic, the better they will provide access to international airspace. The key question is what should be the role of NATO and its level of participation in the security of international airspace. From EU point of view, all the member states have to respect the initiative Single European Sky and the delegated permissions to the organization for Eurocontrol in the field.

Taking into account that the potential opponents develop contemporary technologies (such as air drones) and different kind of barriers to the free access to the air domain, NATO should be prepared in the cases of response needed for collective defense in the field.

The high level of Alliances’ interdependence, the uncompleted level of military compatibility between all member states, the further need of joint intelligent information exchange, the change in the air force strategies from short range missiles to long range surface-to-air (SAM) and advanced generation air-to-air missile as well as the vulnerability of Anti-Ballistic Missile and Anti-aircraft warfare (AAW) systems, suppose NATO to determine its:

- role in the field;
- level of preparedness and readiness in order to be adequate to the changing security environment despite of the defense budget restrictions in the member states;
- level of trust and intelligent information sharing between the Allies, taking into account the political contradictions between Turkey and Cyprus;
- conclusions and lessons learnt from the so called modern wars;
- a better communication strategy to Russia, concerning Deployment of NATO anti-ballistic missile systems in Eastern Europe which is to protect the territory and the population in Europe, including Russia, not being against it.

4/ Concerning the Outer space it’s of key importance to be assured the protection of ground-based installations for management of space systems and facilities from physical damage and cyber-attacks, which could cause collapse. For more security and optimization of capabilities and knowledge in the field, it’s needed to have more coordination between the member states of NATO and EU as well as between both organizations.

In addition given possible scenarios and the trend toward further commercialization in space, planning needs to be done well in advance of operations, to identify and integrate space requirements into the strategic and operational phases. Such planning will help identify uncertainties that can have an effect on capabilities-based planning. In order to overcome the vulnerability of NATO in the field, the Alliance needs of comprehensive space policy.

The emerging problems and challenges suppose NATO and European space agency to initiate a well-coordinated policy for free access to Outer space, which could guarantee the peaceful use of it by the industry and military spectrum of stakeholders.

5/ The strategic concept of NATO and the NATO Cyber defense concept give a new impulse for better cooperation, as the most developed countries in the field are respectively the most vulnerable from cyber-attacks. For this reason the armed forces of the Allies should be well trained and dispose with necessary capabilities to act in a complicated cyber environment. Part of the good coordination policy is the well planning, preparation and trainings.

In addition, NATO and the EU, with a large overlapping membership, should be able to collaborate effectively on a comprehensive approach to cyber security. This would help eliminate duplication, improve capacity and sharing, and satisfy the needs of both organizations to enhance cyber security.

NATO and EU should accelerate their joint efforts to prevent and respond to cyber-attacks and challenges though capacity building and protection of their communication, command and control systems.

The free access of NATO and EU to the global commons (high seas, airspace, Antarctica, Outer space and cyberspace) is of extremely importance for the capabilities of the both organizations to achieve their strategic goals and ambitions, guarantying the security of the Member-state citizens and their economies. The main challenges concerning the global commons are related to: the emergence of non-state actors, new class of weapons and air drones systems; high level of interdependence and interconnection; budget restrictions for modernization in the field of security and defense as a result of financial and economic crisis; the existing, but uncompleted regulations in the field.

As a response of those challenges, the main recommendations are related to the need of: more trust between EU and NATO member states, exchange of information and intelligence; higher level of integrity, compatibility, complementary of Alliances’ capabilities; optimization of the available resources through the principles of “smart defense” and “pooling & sharing”; further development of the intelligence and monitoring capabilities; initiation of European defense semester; free access to global commons following the principles of cooperation, mutual problem and claims solving.

IV. UKRAINE: LESSONS FOR THE COUNTRIES FROM THE WIDER BLACK SEA REGION

The situation in Ukraine is an example of the so called “new war” - an internal conflict that is destabilizing the region. The challenge here is to find the right balance between respect for state sovereignty and the need for...
timely actions in response to violence in order to defend citizens’ human rights. And this challenge is valid for the EU, NATO and the international community as a whole.

Additional challenges are:
- the different approaches of Europe, NATO and US in the conflict situations;
- the contrast between the active and strong France-Germany leadership in the name of Europe and the simultaneous faceless of the EU itself;
- the vision of Moscow for a new alternative of the current existing security system in Europe, promoting the idea of Eurasia and Eurasian security community opposed to the Euro–Atlantic one.
- the use by Russia of democratic tools (as referendums) in order to legitimize non-democratic objectives and actions;
- the close relations of the considerable number of socialist and nationalist parties in the post-Soviet space in Europe with the current Russian government and business, which abuse with the positive historical and cultural memories of the silver generation as well as with the Slavic and Christian orthodox people sentiment in order to promote economic and energy projects, which are in the geostrategic sphere of influence of Moscow;
- the different perceptions about threats, of EU and NATO member states and Russia, which is still supporting the balance of power concept and opposing the process of NATO’s Eastern enlargement.

The first demonstration of direct attack against NATO enlargement to the East was the negative reaction of President Putin from the NATO summit in Bucharest in 2008, concerning the welcomed Georgian and Ukrainian Euro-Atlantic aspirations for membership in the Alliance and expressed willingness for a Membership Action Plan process of both countries.

The second demonstration of Russia’s aggressive behavior provoked by a similar motivation was the invasion in Georgia in 2008 and the breakaway of South Ossetia and Abkhazia.

The war of Russia against Georgia in 2008 and the withdrawal of South Ossetia and Abkhazia from the Georgian territory put the Black sea region in a new geopolitical reality, which should be strictly analyzed in order to answer the question how the geopolitical dynamics within the region will affect the energy and transport infrastructure. The annexation and accession of Abkhazia and South Ossetia to Russia brings closer the only independent of it oil pipeline from Caspian sea: from Baku (Azerbaijan) through Tbilisi (Georgia) to Ceyhan (Turkey), built by international consortium, led by the British-American company “British petroleum”, without the participation of Russian companies.

The third comparable demonstration was recently in Eastern Ukraine, related to the annexation of Crimea and military activities.

The annexation of Crimea gives three strategic advantages to Russia.

The first one is related to the fact that in this way the Black sea navy of Russia has an easy access to the basis of a country with increasing Euro Atlantic orientation. With the acquisition of Sevastopol and the other military basis in Crimea, Russia reestablished its previously destabilized strategic military advantage in the Black sea. The annexation of Crimea and Abkhazia give more opportunities for the deployment of a large navy. In this regard Moscow declared in a very open way its intentions to enlarge and modernize its navy at the Black sea. In addition, Russia has the status advantage to limit the foreign ships’ presence in Black sea as it is a closed sea area.

The second advantage from the annexation of Crimea is related to the triple increase of Russian zone of influence in the Black sea shelf as well as the gained control over the Sea of Azov. Russia acquired not just the Crimean landmass but also a maritime zone more than three times its size with the rights to underwater resources (especially vast oil and gas reserves), potentially worth trillions of dollars. It makes Ukraine more vulnerable as it is deprived from its own key energy resources, being at the same time energy dependent from Russia. The new maritime territory is three times bigger than the ground territory acquired by Russia with the annexation of Crimea.

The third advantage is related to the increased control of Russia over the transport communications in Black sea guaranteeing the safety of its deliveries to sea.

In the final report of the High representative for the December 2013 European Council on Security and Defense, it is noted that the security challenges in Europe come from the South, emphasizing on the Arab uprisings which led to increased instability and conflict. To the east, the focus in mainly on the frozen conflicts, disregarding potential risks from the emergence of new ones (like in East Ukraine).

Before the Ukrainian conflict there were diverging perceptions of EU and NATO member states about Russia. The countries from Eastern Europe perceived quite often Russia as a threat in front of their security due to their historical background, being in the past beyond the Iron curtain, under totalitarian communist regime, while those from the West perceived Moscow as a potential economic partner.

V. CONCLUSION

Now it is time to change the perceptions from the confusion to clarity in order not only to overcome the current challenges in the wider Black sea area, but to avoid them - to act preventively, not to react.

For this reason there are three main necessities. First the EU needs to create a new European security and defense strategy based on a common security strategic culture. NATO’s strategic concept needs also some updates. Secondly coordination and mutualization of capabilities in EU is needed as well as an effective early warning system, supported by all member states, which to foresee and to prevent such conflicts in the future. Thirdly a change is
needed in the Euro-Atlantic integration approach of the Black Sea countries and post-Soviet space.

Until recently, due to the military and economic reasons, the eastward NATO enlargement got ahead of the EU enlargement. As Russia needs to be convinced that Euro-Atlantic integration doesn’t put its interests at risk, it is better the countries from the post-Soviet space to integrate first to EU and then to NATO, Euro-Atlantic integration.

The approach of “pooling and sharing” of resources is well perceived in principle, but not implemented in practice. In this regard there is a big potential, but still not assumed importance by some member states and EDA of the idea, dated from 2013, of Bulgarian minister of defense for a “soft” security capability white paper. It is a proposal concerning the need of a platform for European analysis of the challenges and defense capabilities needed. The immediate goal of such comprehensive review is to overcome the exiting capability gaps. In long term the ambition is to build up, develop and maintain the necessary EU capabilities for CSDP operations and missions. Such a White paper will identify the existing deficits and surplus in the field as well as will suggest wider range of potential and effective decisions, as one of them is the initiative for Pooling and sharing. European defense agency could coordinate such a process, which aim is not only to avoid duplication of efforts and resources, but also to invest in the capabilities that are really needed given the characteristics of current challenges and anticipated strategic environment. During the last years EDA is focusing mainly on the military industrial sphere and not on the EU policy making in the field, needed after the Lisbon treaty.

The “soft-power” narrative shapes the image of the EU as a “soft” security provider. This image should be part of a strategic vision with clear goals and instruments for their achievement.

The relations between Russia and NATO have military and political dimension while those between Russia and EU are related to their economic interdependence and the absence of geopolitical rivalry, which is a good basis for dialogue and mutually acceptable decisions.

The complex character of security threats supposes the implementation of hybrid type of security strategies.

It is more important for the future of Europe to be given priority to the enlargement of the economic space to the East and not to the eastward Euro-Atlantic one. The priority for NATO enlargement could be given to the Western Balkans, while EU should mobilize efforts and focus on Eastern partnership initiative.

Concerning the Black sea, it should be noticed that the frozen conflicts the accession of Georgia, Ukraine and Moldova to NATO, because countries with unsolved territorial problems could involve the Alliance in dangerous military confrontation. The frozen conflicts could be also perceived as a buffer zone between Russia and Europe.

In this regards, an overall EU Black sea strategy is needed, in order to have a targeted policy of the Union in the wider Black sea area. NATO could also initiate a structural partnership with Black sea countries, similar to the existing form of Mediterranean dialogue.

A key moment in the preparation/actualization process of strategic security documents is to be taken into account the following points: the interdependence between the energy policy of EU and the CFSP/CSDP as well as the hybrid character of threats and challenges, which suppose the implementation of comprehensive approach, combining military and civil instruments.

Given the complex character of security threats, the EU and NATO member states should overcome the high level of sensitivity towards their sovereignty in the context of energy issues, as a part of collective security and defense.

The free access of NATO and EU to the Global commons – High Seas; the Atmosphere; Antarctica; Outer and Cyber Space should also be taken into account in the process of strategic documents’ modernization in the field of security and defense as it’s of key importance for the capability of both organizations to achieve their strategic objectives and ambitions, guaranteeing the security of member states’ citizens and the stability of their economies.

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Methodical Aspects for Measuring Customers’ Satisfaction of eServices in Automated CRM Systems

Roumiana Y. Ilieva 1, Delyana Gashurova 2

Abstract The main purpose of the paper is to identify a method for measuring customers’ satisfaction of eServices in CRM systems. The research is conducted through elaborate overview analysis of enterprises using ERP systems. On the bases of the analysis suggestions for companies relying on CRM systems, a conceptual agenda for agile BI monitoring of service quality and client’s perceptions is proposed.

Index Terms: Customer Intelligence (CI), Business Intelligence (BI), CRM, ITIL, service delivery, service quality, customer’s satisfaction, customer survey.

JEL: M31, M37.

I. INTRODUCTION

Stimulated by the dynamic changes in business environment E-commerce and B2B have increased their significance during the last decades. Interaction between growing competitiveness of business organizations and technology development have forced companies to find a way of evolving and keeping up with market trends. Some of the main challenges that business units need to cope with are the adequate variety of services in their portfolio, service standards and effectiveness, flexibility and customer’s loyalty. Focusing on client’s relationship and customer retention is a common approach when aiming at sustainable business development and organizational agility. In order to have a real glance at their market position, management board need to put priority on measurement and monitoring of customers’ perceptions of provided services.

In correspondence with technology innovations and emerging solutions on the market, many companies invest in Customer Relationship Management (CRM) systems. This is preferred method for delivering better customer value. CRM can be described as an enabler factor for higher standards of service effectiveness and continuity in service delivery. A fully integrated system for customer relationship management provides easiness in management from the first point of contact with client through all the phases of customer support and later on.

The aim of such systems is to maintain close relationship with clients and strengthen the competitive and sustainable advantage of the services they provide customers’ satisfaction.

These systems also provide managers with complete and timely information for management decisions and ensure effective data exchange with business partners. However, few companies have invested effort in terms of having a continuous measurement strategy of CRM that can signal potential dips in real-time.

Subject of this study are the Customer Intelligence (CI) or Business Intelligence (BI) techniques for monitoring the customers’ satisfaction of eServices provided in CRM. The main objective of this paper is to derive a conceptual agenda for agile measurement of customers’ satisfaction in order to achieve an appropriate structure for further evaluation and enhancements of services characteristics. This paper, at the same time provides a brief review of some of the relevant approaches that have been used for such purposes.

The research is divided into four main parts. First one presents a state-of-the-art on issues in relation with CRM and companies strategy for gaining competitive powers. Second part explores the concepts of service delivery, quality of service, methods for measurement of quality and customer’s satisfaction and retention. Third part derives a conceptual agenda for monitoring the customer satisfaction through the techniques of a survey. The last section discusses and summarizes the conclusions seeking to present some suggestions for the future development in this area.

II. CONCEPTS OF SERVICE DELIVERY AND CUSTOMERS’ SATISFACTION

The study focuses on service delivery and how it affects clients’ perceptions and evaluations. According to Grönroos, C., 2001, a service is a process that leads to an outcome during partly simultaneous production and consumption processes. ITIL defines a service as "a means of delivering value to customers by facilitating outcomes customers want to achieve without the ownership of specific costs and risks.” In other words customers obtain benefits by renting the right to use a physical object, to receive an expertise or support from a competent personnel, or to pay for access to facilities and networks. In this way customers gain benefits without becoming an owner of the service itself. Quality of services is subjective.
matter depending on the group of users and area of service. Therefore there is no consensus on a definition for quality, yet there are some key points that are common to almost all the definitions of quality, such as perceptions, expectations and the actual outcome experienced by the customer (Cudjoe, A., et al., 2015).

Service quality as perceived by the customer is the degree and direction of discrepancy between customer service perceptions and expectations (Parasuraman et al., 1985). As defined by Grönroos, C., 1984 service quality is a perceived judgment; resulting from an evaluation process where customers compare their expectations with the service they perceive to have received. Therefore, quality can be defined as the perceptions customers have gained compared to their initial needs and expectations. Client’s evaluations are the response to customers’ needs and demands compared to what the service provider has offered them. If we proceed from common definitions of service quality that are present in literature, we can summarize that meeting customers’ needs and requirements and how well the service delivered matches their expectations is the key to high levels of customer satisfaction.

The ability of an organization to determine customer needs and to effectively meet their demands has a great impact on service quality. Therefore main objective of any business is keeping high levels of service quality, as a method for ensuring high competitive powers. Companies that take in consideration what are the levels of their customers’ happiness from service delivery grow and flourish, by establishing a strong relationship between client and vendor. Yet there are many companies that do not put a high priority on these metrics. This is partly due to the fact that measuring customer satisfaction is not as straightforward as e.g. measuring systems’ availability and performance, thus making it hard to set up clear goals.

Because of these complexities, various measuring models have been developed for measuring perceptions of service quality (Grönroos, C., 1983; 1990; Parasuraman et al., 1985; 1988; 1991; Stafford, 1996; Bahia and Nantel, 2000; Aldlaigan and Buttle, 2002). The SERVQUAL model of Parasuraman et al. (1988) proposes a five-dimensional framework of perceived service quality: tangibles; reliability; responsiveness; assurance; and empathy – with factors reflecting both expectations and perceived performance. According to Gabbie and O’neill, 1996, SERVQUAL instrument uses 22 questions evaluating the performance across the five determinants, using a seven-point Likert scale measuring both customer expectations and perceptions. Positive results of Service Quality Index (evaluation of the service is greater than the expected one) is considered as high quality service.

Customer Intelligence (CI) is a key component of CRM. CI enables to get insight into customers’ behaviour by analysing customer data. Using Business Intelligence (BI) methods a company is able to describe, predict and influence customers’ behaviour. Data Mining or knowledge extraction is the application of a scientific method to data to obtain useful information. The heart of the scientific approach to problem-solving is rational hypothesis testing guided by empirical experimentation.

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**Fig. 1.** Data visualization in a BI system

Data mining attempts to answer the following questions:

- What kinds of patterns are in the information?
- What are the main characteristics of these patterns?
- Can meaning be endorsed to these patterns and/or their changes?
- Can these patterns be presented to users in a way that will facilitate their assessment, understanding, and exploitation?
- Can a machine learn these patterns and their relevant interpretations?

The pyramid in Figure 2 shows the main building blocks of a business intelligence system.
III. A CONCEPTUAL AGENDA FOR SATISFACTION MEASUREMENT

There are several ways to gather input from customers. The simplest way to find out how customers feel and what they want is to ask them. The most efficient and economical way to measure customer satisfaction is to create customer satisfaction surveys with the help of a survey software solution. An advanced survey software solution can manage various survey research methods – create the same survey in different formats; include online surveys, email surveys, paper surveys, mobile surveys, and telephone surveys – depending on the preferred way to reach client. The purpose of this type of survey is to gauge how satisfied are customers from the services provided. The end goal of a customer satisfaction survey is to get customer feedback based on which corrective actions can be taken in order overall customer experience to be improved. One of the main advantages of performing customer survey is collecting feedback on various aspects of the eServices in CRM. Regularly scheduled online surveys or email surveys, thus receiving instant customer feedback assures the accuracy in a timely manner. Customer surveys with standardized survey questions insure collection of the same information from all target groups. By launching a customer survey as an attempt to find out how services can be improved, customers will feel less put upon.

Some of the dimensions commonly used for measuring service delivery with surveys are:
- quality of service
- speed of service
- pricing
- complaints or problems
- trust in employees
- competence of personnel
- types of other services needed
- the closeness of the relationship with contacts

Overall process objective is to measure and report the satisfaction from eServices delivered to the customers and identify relevant improvement actions and plan. Performing evaluation of services based on surveys is complex method containing multiple steps.

In the proposed agenda for customer satisfaction survey can be seen the main concepts standing behind implementation of this monitoring method. Main actors in the process are the leadership team, survey administrators and the clients. Survey process is divided in the following 3 phases:

A. Survey preparation
In this phase survey administrators are responsible for design of the questionnaire and timelines for execution or updates of the already existing ones. Next step is approval of the prepared calendar and questionnaire by the responsible leadership team of the company. Measuring customer satisfaction must be a continuously, consistent, timely, accurate and reliable process which is why it is recommended to be scheduled on monthly or weekly bases depending on the approved calendar. When the proposed changes are accepted survey administrators need to collect and extract the necessary recipients’ information like names, address, email etc.

B. Survey execution
Once completion of user details extraction is done surveys are sent to the customer. If there is no response from clients after a certain period of time a reminder is sent. Closing of survey is executed when the user completes it or if there is no feedback after the reminder. At that point administrators are responsible for analysis and reports creation of the collected data.

C. Report results
In the final phase after data analysis results are communicated to the leadership and preventive and corrective actions are considered in case of low customers’ satisfaction levels. Continuous tracking of satisfaction results is often part of a management initiative to assure quality is at high levels over time.

Tracking of customer satisfaction from eServices in CRM draws a trend line how an organization is performing relatively to competitors in the same industry. Therefore customer satisfaction research should be done with greatest care. Efficient customer satisfaction management requires a long term vision and strategy, and a dedicated team for survey administration and control. For consistency and transparent survey processes it must clear the process of survey organization and reporting. The challenge for organizations is to implement and secure a standardized customer satisfaction process across their business area. For that reason organizations could definitively take advantage of a proven systematic customer satisfaction process.

The conceptual agenda on which the research is structured in a Customer Satisfaction Survey Life Cycle manner (fig.3) is based on a significant theoretical background. It explores the relationship between monitoring of the clients feelings and perceptions of the services and reflections over company’s overall performance.
Customer Intelligence (CI) is a key component of CRM. CI enables to get insight into customers' behaviour by analysing customer data. Using Business Intelligence (BI) methods a company is able to describe, predict and influence customers' behaviour. Data Mining or knowledge extraction is the application of a scientific method to data to obtain useful information. The heart of the scientific approach to problem-solving is rational hypothesis testing guided by empirical experimentation. Data mining attempts to answer the following questions:

- What kinds of patterns are in the information?
- What are the main characteristics of these patterns?
- Can meaning be endorsed to these patterns and/or their changes?
- Can these patterns be presented to users in a way that will facilitate their assessment, understanding, and exploitation?
- Can a machine learn these patterns and their relevant interpretations?

IV. CONCLUSIONS

Companies today realize that one of the keys to successful business in the competitive marketplace is the effective customer management. Keeping high levels of customer relationship can be accepted as a strategic advantage. This is the reason many industries invest a lot of effort in making sure that Customer Relationship Management based on BI analytics is high on the priority list. From the conducted overview it can be concluded that customer satisfaction can be defined as an overall customer attitude towards a service provider and experience from services received.

To coordinate continuous improvement efforts all activities should be processed according a plan approved by responsible organs, surveys execution, monitoring of collected results and metrics for corrections. Customer satisfaction program should start with careful planning, should result in effective action and last but not least should be measured and analysed in a continuous and consistent BI manner. Considering the effect of customer satisfaction of service quality on customer retention, the study evaluated that companies should focus their objectives on keep a track of customer levels of satisfaction. As preferred method for performing
satisfaction monitoring is recommended a customer survey approach.

ACKNOWLEDGEMENTS

The research, described in this paper, was carried out within the framework of R&D Project in support of PhD student (session 2015), contract № 152ПД0059-15.

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Ivan Altaparmakov

Abstract. Simulations of spherical tetrahedron shaped body for ball mill are made. The impact of spherical tetrahedron shaped body against a plate was modeled via explicit Finite Element Method. Distributions of Strain and Stress and Force to time diagrams are obtained for three cases of impact. 1. Impact of spherical tetrahedron spherical surface against a plate. 2. Impact of spherical tetrahedron tip against a plate. 3. Impact of spherical tetrahedron edge against a plate. Conclusions about the workability of the spherical tetrahedron shaped body are made.

Index Terms: spherical tetrahedron, impact, ball mill, FEM.

PACS: 45.50.Tn, 83.50.-x, 89.20.Bb

I. INTRODUCTION

Impact of a spherical body against massive plate is a classical problem in impact mechanics [Bepnep; Stronge]. The most recent area in these researches is performed using FEM modeling of the processes [Chuan-Yu Wu, L.Y.Li and C. Thornton ; Wu C.Y., L.Y.Li and C.Thornton; E. Jaquelin, J.P.Laine, A.Bennani and M.Massenzio].

Application of impact of spherical body against massive plate with small velocity is in ball mils. Such mills are used in mining industry for ore grinding in the production of cement, clinker grinding, in thermal power for grinding coal and chemical industries for milling of commodities. In mills using balls with a spherical shape, efficiency of these aggregates is very small - 2-5%. It is important that only the grinding of ore worldwide is consumed 6% of the electricity produced so the issue of improving the efficiency of operation of ball mills is of great practical use.

One way to increase work efficiency on ball mills is the replacement of the spherical grinding bodies with such other forms. In the Republic of Bulgaria is patented grinding body in the form of spherical tetrahedron, the use of which leads to significant increases in productivity and reduction of energy consumption [L.Tzotzorkov, T.Penchev, P.Bodurov and L.Kuzev]. Because of the novelty of this form of milling body, so far there have been no theoretical studies to determine the effect of its application.

The purpose of this work is to be modeled by FEM the stress-strain state of deformation on impact of various elements of the surface of the spherical tetrahedron shaped ball on flat plate and to determine the size of the force at the time of impact.

II. FORMULATION OF THE PROBLEM.

In the present work was studied stress-strain state and force upon impact of a spherical tetrahedron shaped ball in a solid plate, while the contact between ball and plate is with various elements of the surface of the ball - a spherical surface, edge and tip. (Figure 1.a, 1.b, 1.c).

The study was conducted as impact process is modeled by Finite Element Method (FEM). The licensed software ANSYS was used. Corresponding governing differential equation for the problem solved by FEM is:

\[ \sigma_{y,j} + \rho f_j = \rho \ddot{x}_j \]  

(1)

And corresponding boundary conditions: traction on boundary \( \partial b_1 \), displacement on boundary \( \partial b_2 \) and contact discontinuity along an interior boundary \( \partial b_3 \):

\[ \sigma_j n_j = t_j(t), \quad x_j(X_j,t) = D_j(t), \quad (\sigma_j^+ - \sigma_j^-) n_j = 0 \]  

(2)

Here \( \sigma_j \) is Cauchy stress, \( \rho \) is the current density, \( f \) is the body force density, \( \ddot{x} \) is acceleration, the comma \( \partial b_i \) denotes covariant differentiation and \( n_j \) is a unit outward normal to a boundary element of \( \partial b_i \). We can write this as:

\[ \int \left( \rho \ddot{x}_j - \sigma_j - \rho f_j \right) dx + \int_0^t \left( \sigma_j n_j - t_j \right) d\tau + \int_0^t \left( \sigma_j^+ - \sigma_j^- \right) n_j d\tau = 0 \]  

(3)

Where \( \partial b_i \) satisfies all boundary conditions on \( \partial b_i \) and the integrations are over the current geometry [LS-DYNA].

The ball has the following characteristics: radius of spherical surface 86 mm, radius of rounding is 5 mm. It is assumed that the ball is perfectly linear elastic with modulus of elasticity of steel 45 (0.45% Carbon) - 2.1E+005 MPa, i.e. not taken into account plastic deformations and strain stiffening. It is assumed that the ball falls from a height of two meters and at the moment of contact has a speed of 6.28 m / s. During the impact the plate to ensure the solidity of the slab, it has dimensions 100 x 100 x 50mm, and is made of the same material as the ball.

On Figure 1.a is shown meshing with FE of the ball and plate. The finite elements mesh is not very fine because at this stage the aim is to evaluate the approximately studied...
parameters. Approximation makes sense since inside the mill processes are too complex and their evaluation is statistical.

Figure 1.b shows the scheme of the bodies and the finite elements mesh for the case of a collision of the tip of the ball into the slab. Elements are relatively large because they had not pursued very high accuracy of the decision.

Figure 1.c shows a scheme of the bodies and finite elements mesh for the case of a collision of a ball edge into the plate. It turned out that finite elements mesh are too large, which does not allow very precise conclusions about the nature of the processes. We may need further investigation of this case with a fine finite elements mesh.

### III. RESULTS

Figures 2.a.1 and 2.a.2 shows a diagram of stress in the contact point between ball and plate and diagram of forces depending on the time of impact of the spherical surface of the ball in the slab. Contact Point is one of the heaviest loaded points on impact. It is seen that stress reached almost 1125 MPa. Force reached 180 000 KN, then decreases to zero. After the impact, some fluctuations remain in stress which indicates that in the body remain to be distributed elastic shock waves or sound but with minor magnitudes. The duration of impact is about 0.2 ms.

Fig. 2a.1. Diagram of stress in the contact point between ball and plate depending on the time of impact of the spherical surface of the ball in the slab.

Fig. 2a.2. Diagram of forces between the ball and plate depending on the time of impact of the spherical surface of the ball in the slab.

Figure 2.b.1 and 2.b.2 shows a diagram of stress in the contact point between ball and plate and diagram of forces depending on the time of impact of the tip of the ball in the slab. In this case the stress reaches 2500 MPa - larger than in the previous case but the overall picture of the load is...
similar to the previous case. Forces reach 140000 KN. The duration of impact is about 0.3 ms. In this case, the residual vibrations are of small amplitude or absent at all.

Figure 2b.1 Chart of stress at the contact point between ball and plate depending on the time of impact of the tip of a ball in the slab.

![Chart of stress at the contact point between ball and plate depending on the time of impact of the tip of a ball in the slab.](image)

Figure 2b.2 Diagram of forces between the ball and plate depending on the time of impact of the tip of the ball in the slab.

![Diagram of forces between the ball and plate depending on the time of impact of the tip of the ball in the slab.](image)

Figure 2c.1 Diagram of stress in the contact point between ball and plate depending on the time of impact of the edge of the ball in the slab.

![Diagram of stress in the contact point between ball and plate depending on the time of impact of the edge of the ball in the slab.](image)

Figure 2c.2 Diagram of forces between the ball and plate depending on the time of impact of the edge of the ball in the slab.

![Diagram of forces between the ball and plate depending on the time of impact of the edge of the ball in the slab.](image)

Figure 3a shows the distribution of the stress intensity in a section which passes through the edge perpendicular to the edge and through the spherical surface of the ball at the moment of the highest load. It is seen that stresses are mainly focused at the tip of the ball and the gradient is very large. Reached value of the stress is about 41,643 MPa. Stress in the slab reaches tens of MPa.

Figure 3b shows the distribution of the intensity of stress in a section which passes through the edge and through the spherical surface of the ball at the moment of the highest load. It is seen that stresses are mainly focused at the tip of the ball and the gradient is very large. Reached value of the stress is about 41,643 MPa. Stress in the slab reaches tens of MPa.

Figure 3.c.1 shows the distribution of the stress intensity in a section which passes through the edge perpendicular to the edge and through the spherical surface of the ball at the moment of the highest load. It is seen that stresses are mainly focused at the tip of the ball and the gradient is very large. Reached value of the stress is about 41,643 MPa. Stress in the slab reaches tens of MPa.

Figure 3.c.2 shows the distribution of the intensity of stress in a section which passes through the edge parallel to the edge and through the spherical surface of the ball at the moment of the highest load. (Anomalous distribution of stress in the slab may be due to the fact that stresses are...
Stresses are concentrated again in the impact area were distributed inside the ball with a relatively low gradient. Stresses reached to 7500 MPa - less than in the section perpendicular to the edge of the ball. This can be explained by the type of area with large strains in perpendicular directions, namely two parts with large stresses side and a band of lower stresses in the middle - where the section runs parallel to the edge of the ball. In a slab there is wide strip with increased pressure - up to 6000 MPa - which again can be attributed to the separation operation on the edge of the ball. This case will require further detailed studies with a small network of finite elements.

Figure 4.a shows the distribution of the intensity of strains in a section which passes through the edge and through the spherical surface of the ball at the moment of the highest load. Again strains are larger in the ball and field with large strains is elongated form directed toward the center of the ball. In the plate strains are small and the deformed zone has a characteristic elongated shape.
are concentrated in the area below the point of impact with not very large gradient. 

Figure 4.b shows the corresponding distribution of the strain intensity in a section which passes through the edge perpendicular to the edge and through the spherical surface of the ball at the moment of the highest load, distribution and strain intensity in a section which passes through the edge parallel to the edge and through the spherical surface of the ball at the moment of the highest load. This picture is similar to the picture of stress.

IV. DISCUSSION OF RESULTS AND CONCLUSIONS

As a conclusion it can be concluded that the balls are considered good by destroying power and in the edges this capability is aimed at separation of the lower bodies. Durability of the bodies is also great especially in the spherical surface due to waves which are received at the impact to the spherical surface. Waves in this case are determined by the specific shape of their bodies. Increased radius of the spherical surface lower the gradients of stresses and lowers the maximum stress, this way wear resistance is increased. Lower radius at the tips and edges increases stress gradients and maximal stress, this way the destruction capabilities of the spherical tetrahedron is increased. Significant stresses reached shows that stress stiffening at the surfaces, tips and edges will have significant impact to wear resistance of spherical tetrahedron.

ACKNOWLEDGMENTS

The author would like to thank to Ministry of Education and Science (Bulgaria) National Science Fund, contract ID 09 0048 for their supporting this research

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Ivan Altaparmakov

Abstract. Simulations of spherical tetrahedron shaped body for ball mill are made. The impact of spherical tetrahedron shaped body against a tip of fixed spherical tetrahedron was modeled via explicit Finite Element Method. Distributions of Strain and Stress and Force to time diagrams are obtained for three cases of impact. 1. Impact of spherical tetrahedron spherical surface against a tip of fixed spherical tetrahedron. 2. Impact of spherical tetrahedron tip against a tip of fixed spherical tetrahedron. 3. Impact of spherical tetrahedron edge against a tip of fixed spherical tetrahedron. Conclusions about the workability of the spherical tetrahedron shaped body are made.

Index Terms: spherical tetrahedron, impact, ball mill, FEM.
PACS: 45.50.Tn, 83.50.-v, 89.20.Bb

I. INTRODUCTION

The study of collision between two bodies is primarily the impact of two spheres attached at one point through a connecting line element [Bepnep; Stronge]. In this case there are considered two options - one body is stationary and the other is placed on it from a certain height, the two bodies move against each other. The most recent researches in this area are conducted using FEM modeling of the processes [Chuan-Yu Wu, Li and Thornton; Wu C.Y., Li and C.Thornton; Jaquelin, Laine, Bennani and Massenzio].

Application of impact of spherical body against other spherical body with small velocity is in ball mills, where part of the ball load rises to a certain height and then falls freely on other stationary balls. Collision between moving and stationary balls, in the case of spherical tetrahedron shaped balls there are several possible combinations of hitting surfaces.

The purpose of this work is to be modeled by FEM the stress-strain state of deformation on impact of various elements of the surface of the spherical tetrahedron shaped ball on the tip of other (fixed) spherical tetrahedron and to determine the size of the force at the time of impact.

II. FORMULATION OF THE PROBLEM.

In the present work was studied stress-strain state and force upon impact of a spherical tetrahedron shaped ball on the tip of other (fixed) spherical tetrahedron, while the contact between ball and he tip of other spherical tetrahedron is with various elements of the surface of the ball - a spherical surface, edge and peak. (Figure 1.a, 1.b, 1.c).

The study was conducted as impact process is modeled by Finite Element Method (FEM). The licensed software ANSYS was used. The ball has the following characteristics: radius of spherical surface 86 mm, radius of rounding is 5mm. It is assumed that the ball is perfectly linear elastic with modulus of elasticity of steel 45 (0.45% Carbon) - 2.1E +005 MPa, i.e. not taken into account plastic deformations and strain stiffening. It is assumed that the ball falls from a height of two meters and at the moment of contact has a speed of 6.28 m / s. During the impact the other spherical tetrahedron is fixed and is made of the same material as the ball.

Fig.1a. Scheme of the bodies and the finite elements mesh for the case of a collision of spherical surface of a ball on top of another ball.

Figure 1.a shows the scheme of the bodies and the finite elements mesh for the case of a collision of spherical surface of a ball on tip of another ball. Here the bottom ball is fixed rigidly on the lower spherical surface.

Figure 1.b shows the scheme of the bodies and the finite elements mesh for the case of the impact of a ball tip on tip of another ball.

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Figure 1.c shows a scheme of the bodies and finite elements mesh for the case of impact of the edge of the ball on tip of another ball. That objects with relatively large mass collide by surfaces with a relatively small radius of curvature.

![Figure 1b Scheme of the bodies and the finite elements mesh for the case of impact of a ball tip on tip of another ball.](image)

![Figure 2a.1 Diagram of stress in the contact point between the balls depending on the time of impact of the spherical surface of a ball on tip of another ball.](image)

![Figure 2a.2 Diagram of forces between the balls depending on the time of impact of the spherical surface of a ball on tip of another ball.](image)

![Figure 2b.1 Diagram of stress at the contact point between the balls in dependency of the time of impact of the tip of a ball on tip of another ball.](image)

![Figure 2b.2 Diagram of stresses in the contact point between the balls and a diagram of forces depending on the time of impact of the edge of the ball on tip of another ball is shown in Figure 2.c.1 and 2.c.2. Chart has the features of other cases. Stresses reached up to 6400 MPa and the](image)

III. RESULTS

Figure 2.a.1 and 2.a.2 shows a diagram of stress in the contact point between the balls and a diagram of forces depending on the time of impact of the spherical surface of a ball on top of another ball. As shown in Figure 2.a.1 loads is a very complex character over time which may be associated with the distribution of mechanical waves in the ball. Stresses reach about 3600 MPa - stress in previous cases reached over 1000 to 2000 MPa. Forces reached 120 000 KN.

Figure 2.b.1 and 2.b.2 shows a diagram of stress in the contact point between the balls and a diagram of forces depending on the time of impact of the tip of a ball on tip of another ball. Nature of the diagram is similar to the diagrams of the first case. Stress reaches 1400 MPa and the duration of impact was 0.5 ms. Forces reached 100 000 KN. Time of impact is greater than the previous case and the zone with a large stress is wider. This is due to the fact
duration of impact was 0.4 ms. Forces reach 110,000 KN. Residual vibrations are negligible.

This phenomenon could have a beneficial effect on the durability of the ball. This case deserves detailed study with a small network of finite elements.

Figure 3.a shows the distribution of stress intensity in a section which passes through the edge and through the spherical surface of the ball at the moment of highest load. It is seen that stresses are concentrated at the contact point. The stress gradients are significant. Figure shows the separation of the two bodies at the same time the stresses is large. This may be due to the spread of waves in the balls.

Figure 3.b shows the distribution of the stress intensity in a section which passes through the edge and through the spherical surface of the ball at the moment of highest load. From Figure 3.a is seen that the load is concentrated in the contact area. Stresses reached values of about 36,400 MPa. In the fixed ball stresses are about two times smaller. In both cases, the stress gradient is very large, and in the drop ball stresses are larger.

Figure 3.c.1 shows the distribution of stress intensity in a section which passes through the edge perpendicular to the edge and through the spherical surface of the ball at the moment of highest load. It is seen that stresses are heavily concentrated in the area of contact and at the drop ball stresses are larger - reaching 122,000 MPa. In the fixed ball stresses are about two times smaller. In both cases, the stress gradient is very large, and in the drop ball stresses are larger.

Figure 3.c.2 shows the distribution of the stress intensity in a section which passes through the edge parallel to the edge and through the spherical surface of the ball at the
moment of highest load. Again, stress is concentrated in the contact area and gradients in the incident and in the fixed ball are large. Larger gradient is in the incident ball. There is not much difference in picture of the stresses in a section parallel and perpendicular to the edge of the falling ball.

The distribution of the strain intensity in a section which passes through the edge and through the spherical surface of the ball at the moment with the higher load (Figure 4.a.) as well as in stresses shows that the load concentrated in the contact area, which confirms the conclusions made from the stress intensity distribution about the presence of mechanical waves in the ball.

The distribution of the strain intensity in a section which passes through the edge and through the spherical surface of the ball at the moment with the higher load (Figure 4.b) shows a similar nature to the distribution of stress because their bodies are assumed to be made of fully linear elastic material and plastic deformations are neglected.

Figure 4.c.1 and Figure 4.c.2 show respectively the distribution of the strain intensity in a section which passes through the edge perpendicular to the edge and through the spherical surface of ball and distribution and strain intensity in a section which passes through the edge parallel to the edge and through the spherical surface of the ball at the moment at higher load.
It is seen that the nature of the distributions is similar to the nature of stress distribution that can be expected due to the adoption of the linear elastic nature of the processes.

IV. DISCUSSION OF RESULTS AND CONCLUSIONS

As a conclusion it can be concluded that the balls are considered good by destroying power. In the edges this capability is aimed at separation of the lower bodies. Durability of the bodies is also great especially in the spherical surface due to waves which are received during the impact to the spherical surface. Waves in this case are determined by the specific shape of their bodies. As in the previous part increased radius of the spherical surface lower the gradients of stresses and lowers the maximum stress, this way wear resistance is increased. Lower radius at the tips and edges increases stress gradients and maximal stress, this way the destruction capabilities of the spherical tetrahedron is increased. Significant stresses reached shows that stress stiffening at the surfaces, tips and edges will have significant impact to wear resistance of spherical tetrahedron.

ACKNOWLEDGMENTS

The author would like to thank to Ministry of Education and Science (Bulgaria) National Science Fund, contract ID 09 0048 for their supporting this research.

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