

**University of Economics in Bratislava**  
**Faculty of Business Economics with seat in Košice**

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The aim of the journal is to publish the papers concerned with developing of new knowledge in the field of economic theories and its application in business practice. The scope of the journal covers the wide range of research problems of business economics, management, marketing and finance, knowledge economy, innovation policy, etc. The journal contains empirically (experimentally) founded studies, survey studies, contributions to "Discussion" (personal views and attitudes on controversial issues in economics as science, as a professional practice, etc.) and reviews. Integrative studies documented by relevant data from central and east European regions and member countries of European Union are specially welcomed. All papers are peer reviewed. The journal is published twice a year.

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# INNOVATION STRATEGY OF EU27 COUNTRIES

## INOVAČNÁ STRATÉGIA KRAJÍN EÚ27

*Stela BESLEROVÁ – Zuzana HAJDUOVÁ*

### Abstract

Nowadays businesses recognize the importance of innovation, research and development if they want to maintain competitiveness. Therefore they invest in research and development. A growing trend in the financing of research and development can be seen in all legal forms of business entities excluding public enterprises. Aim of this article is to evaluate innovation performance of Slovakia and countries EU27. Included in the article is summarization of current performance and detailed performance in measured indicators. We evaluate expenditures on research & development and perform regression and correlation analysis of selected indicators. Overall we can conclude that Slovakia is below an average of EU27 countries and there is an importance to focus on new Innovation strategy of Slovakia for 2014-2020.

### Keywords:

research and development, innovation, innovation performance

### Abstrakt

V súčasnosti si podnikateľské subjekty uvedomujú význam inovácií, vývoja a výskumu, ak si chcú udržať konkurencieschopnosť. Aj preto vynakladajú finančné prostriedky na vývoj a výskum. Rastúci trend vo vynakladaní výdavkov na vývoj a výskum prevláda u všetkých právnych foriem podnikateľských subjektov okrem štátnych podnikov. Cieľom tohto príspevku je zhodnotiť inovačnú výkonnosť Slovenska a krajiny EÚ27. Súčasťou príspevku je zhrnutie súčasnej výkonnosti v meraných ukazovateľoch. Zároveň v príspevku hodnotíme výdavky na výskum a vývoj a vykonávame regresnú a korelačnú analýzu vybraných ukazovateľov. Celkovo môžeme konštatovať, že Slovensko je pod priemerom krajín EÚ27, preto je dôležité zamerať sa na novú inovačnú stratégiu Slovenska na obdobie 2014-2020.

**Kľúčové slová:** výskum a vývoj, inovácia, inovačná výkonnosť

### Introduction

Innovation activities are considered to be a driving force of economic development in both the European Union as well as in Slovakia. They develop options for future competitiveness in the form of new knowledge; increase the efficiency of the economy and its competitiveness. Countries, which in the past invested significant funds in these activities are currently on advanced economic level and it multiplies the effect of the investment in science and technology (Innovation Strategy 2007-2013). In terms of introducing innovation, Slovakia in 2005 was one of the weakest countries throughout all EU countries. From all member countries were jointly with Portugal at last place in ranking (Innovation Strategy 2007-2013). The most serious performance problem of innovation is

very low performance of companies in research and development and the related problem of low employment in high - tech services. By 2007, when the government of the Slovak Republic adopted a proposal for the Innovation Strategy for the years 2007-2013, in Slovakia there wasn't any comprehensive innovation strategy. Likewise, there was not any functioning innovation system. There is still not yet fully developed favorable business environment for innovation, as can be monitored by the weak activity in the innovative process of companies. There is lack of technologically oriented business segment, which would become the basis for innovation activity of the country. Therefore a necessity of better support of the creation and growth of innovative companies becomes important. There have been developed several schemes for innovations. The problem is that they are not accessible to all business entities. It is considered a great challenge to raise awareness of both companies as well as public in terms of support activities of government in the sphere of innovations, notably the existence of a variety of innovative programs and consulting and advisory organizations (Innovation Strategy 2007-2013).

### **The meaning of innovation**

Under the the concept of "innovation" we can understand radical or minor change, improvement of product, provided service or business process. Innovation is a key to sustainable growth. Ever since the beginnings of the Lisbon Strategy in 2000, was a priority for European policy makers and in the last decade were created a series of EU initiatives which are directly related to innovation. Innovation has been for long time considered as a key element in competitive strategy (Banbury and Mitchell, 1995; Danneels, 2002). Especially in high-tech industry where technologies are rapidly evolving, companies are investing in research and development to support technological advantage (Balkin, Markman and Gomez-Mejia, 2000). Innovations though don't need to be just of technological nature. We meet with innovations of processes in different areas of the company. Without effective management and communication, innovations would not be possible.

As a founder of the concept of innovation is considered Schumpeter, who defined this area as " a change to exploit new kinds of consumer goods, new production and transportation vehicles, new markets and forms of organization of production and services " (Kováč, 2003). Innovation is preceded by expending some creative activities in the form of eg. inventions, rationalization proposals, projects, industrial designs and so on. According to Schumpeter such creative activity leading to changes in the structure of knowledge we call invention. However, not all new thoughts and ideas are realized. Therefore, as innovation we call just realized results of scientific, research and development activities, so we can say that innovation is implemented invention (Dvořák, 2006). The European Union, in its „Green Paper on Innovation“, identifies innovation as a synonym for the successful production, assimilation and

exploitation of novelty in the economic and social spheres. It offers new solutions to problems and thus allows meeting the needs of the individual as well as society (European Commission, 1995).

In Slovakia, innovation is defined under Law. 172/2005 Coll. on the organization of state support for research and development as: (Innovation Strategy of SR 2014-2020)

- a) new or improved product or new or improved service, which is applicable on the market and is based on the results of research and development or business,
- b) new or improved manufacturing process or distribution method including significant changes in techniques, equipment or software,
- c) new way of organization in business practice, workplace organization or external relations,
- d) transfer of scientific and technological knowledge into practice,
- e) purchase of production-technical and business experience (know-how) acquisition and lease of license agreements rights,
- f) introduction of modern methods in pre-production stages and in the organization of work,
- g) improvement of control and testing methods in the process of production and services,
- h) increase in the quality of work and safety,
- i) reducing negative impacts on the environment,
- j) efficient use of natural resources and energy.

Development of innovation has for economic and social future of Slovakia key importance. Strong economic growth in the years 2000 - 2007 was driven by the world economic boom and by specific competitive advantages of the Slovak Republic, in particular low labor costs and low taxes. This way of competitiveness is not sustainable in long term perspective. The global economic crisis and an aging population substantially change parameters of fiscal sustainability in the Slovak Republic.

### **Innovation performance of EU27**

In 2007, Slovakia was, according to the report "European Innovation Scoreboard (EIS) 2007" grouped among countries such as Bulgaria, Croatia, Greece, Hungary, Latvia, Lithuania, Malta, Poland and Portugal. These countries are in the group „Catching-up countries“ or „moderate innovators“, whose innovation performance is below the EU27 average. EIS defines the ranking of countries according to the summary innovation index (SII). In 2011, Slovakia was ranked on 20th place among 27 EU countries and belonged to the

group of moderate innovators with second lowest innovation performance in the group.

Figure 1 shows the performance of the advanced countries based on summary innovative index. This index determines the order and the group to which the country belongs, and is formed by aggregation of 25 indicators that are used to measure the innovative performance. Groups of countries are divided as follows:

- Innovation leaders - countries exceeding the EU27 average by more than 20%
- Innovation followers – countries in the range of less than 20% above the average and more than 10% below the average
- Moderate innovators - country reaching 50% -90% of the overall performance of the EU27
- Catching-up countries - more than 50% below the average

Compared to 2011, only two countries have changed position in the groups, Lithuania has made improvements and moved to the group of moderate innovators and Poland fell to a group of catching-up countries (Innovation Union Scoreboard 2013)

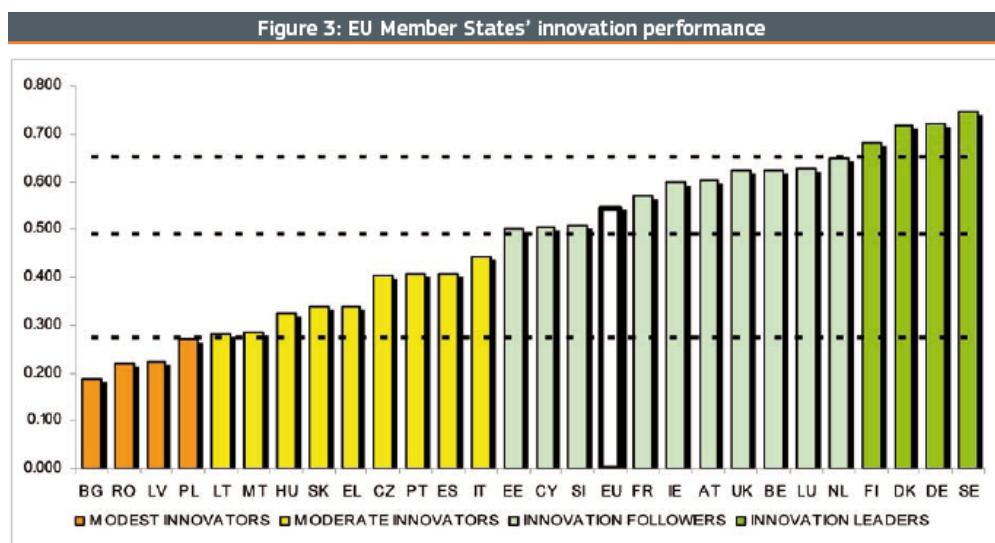


Figure 1

### Overall innovation performance of member states

Source: Innovation Union Scoreboard 2013

From the perspective of growth, each country in the period 2008-2012 reached improvement in the innovation process except Cyprus and Greece. Cyprus has only a small decrease (-0.7%), but the performance of Greece reached a significant decrease (-1.7%). Estonia is a country that experienced the fastest annual increase in performance innovation (7.1%). Slovakia oscillates around 3.5%, to compare; V4 countries have experienced lower growth rates. In



the Czech Republic, an increase of about 2.8%, Hungary was oscillating around 1.4% and among V4 the lowest increase was reached in Poland (0.4%). Table 1 shows the values of SII of Slovakia in period 2008-2012.

Table 1  
SII of Slovakia

Year	2008	2009	2010	2011	2012
SSI	0,285	0,295	0,281	0,291	0,337

Source: Innovation Union Scoreboard 2013

Figure 3 shows the reality in Slovakia, which belongs to the countries with below average performance. Growth in innovation performance differs in some areas compared to the EU 27. Relative strength of Slovakia are human resources, while the relative weakness is the system of research and intellectual assets.

The biggest growth in the EU 27 was achieved in the indicator innovative SMEs collaborating with others. In Slovakia, however, was high growth rates recorded for new PhD graduates, while Slovakia achieved the highest growth of this indicator from all member states. In addition, an increase of over 20% was recorded in the case of patent applications in societal challenges. On the other hand, a strong decline is observed in the case of non-R&D innovation expenditure for more than 19% and decrease in license and patent revenues from abroad for more than 38%. Innovation performance in human resources, finance and support is above the EU27 average (Innovation Union Scoreboard 2013).

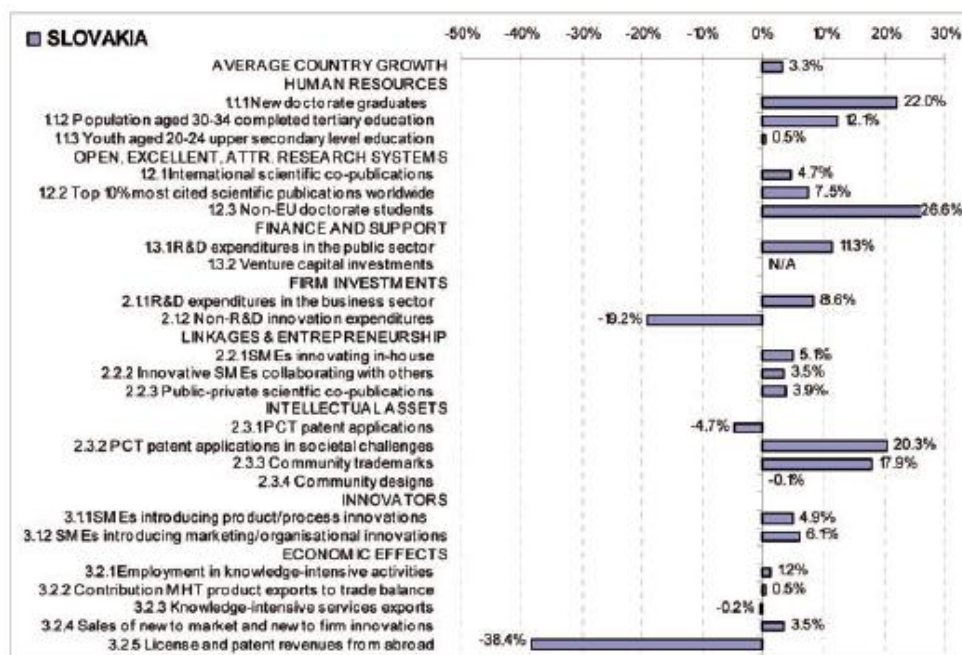


Figure 2

### Performance of Slovakia

Source: Innovation Union Scoreboard 2013

One of the indicators of innovation performance is the research and development. In the next section, we focus on the area of R&D in Slovakia, which lags in total expenditure in comparison with the countries of the European Union. Within the article we monitor the development of expenditures in the period 2008-2012, where there was a continuous annual increase in expenditures in the studied area.

## R&D expenditures

EU countries are investing in R&D on average 1.82% of GDP, in Slovakia it represents 0.63% of GDP, while public funds represent 60% of total expenditure invested in research and development. As a main reason for this is considered less effective research base with low concentration focus on big projects, lack of large enterprises, which invest in research, lack of support from the public sector, low motivation of researchers and so on. Innovations arise primarily in companies, in smaller extent in research laboratories. A key role is played by entrepreneurship.

In the next section, we focus on Slovakia in terms of expenditures on research and development. Since 2006, Slovakia has experienced an increase in investment in research and development. This increase significantly intensified after 2009, which was mainly due to the negative effects of the economic crisis that Slovakia experienced during that period. The crisis resulted particularly in reduction in exports and consumer confidence, which was strongly reflected in the economic growth of Slovakia. GDP in 2009 dropped by 4,9%. Table 2 shows GDP growth rate in period 2008-2012.

Table 2  
GDP growth rate

Year	2008	2009	2010	2011	2012
GDP growth rate (%)	5,8	-4,9	4,4	3,2	2,0

Source: Statistical Office of the Slovak Republic

During the second half of 2009, the situation began to change and the economy in Slovakia began to revive (National program of reforms, 2010). The government began to focus on ensuring the efficient allocation of funds for research projects and created conditions for the promotion of innovation activities in the private and public sector. These reasons are also reflected in the development of expenditures on research and development in the last five years. Table 3 presents R&D expenditures in Slovakia in period 2008-2012.

Table 3

**R&D expenditure in Slovakia in period 2008-2012 (thousand EUR)**

	2008	2009	2010	2011	2012
Total expenditures	316 459	302 994	416 369	468 439	585 225
Expenditures based on financing					
- from public funds	178 368	166 714	238 697	284 729	327 999
- from private funds	138 091	136 280	177 672	183 710	257 227
Share of R&D expenditures in GDP (%)	0,47	0,48	0,63	0,68	0,82

Source: Statistical Office of the Slovak Republic

While watching the various statistical indicators we deal with their development within time. We monitor data from 2008 to 2012 inclusive. It can be seen that in time we dealt with labor costs, which show continuous growth over the monitored period as shown in table 4.

Table 4

**Labor costs**

Year	2008	2009	2010	2011	2012
Labor costs	1067,73	1092,05	1124	1172	1213

Source: EUROSTAT

This can be confirmed through a linear regression model, which is statistically significant, while the average annual increase in labor costs in Slovakia is 37,049 EUR. Therefore, the further development can be assumed based on the observed variables. In this case, we observe that both the regression model, and the range of the regression coefficients are statistically significant as their p-values are less than the significance level, so less than 0,05. In doing so, we must emphasize the high degree of reliability of the model, whereas the index of determination reaches the value of almost 0,98.

Table 5

**Linear regression model of Labour costs**

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	13726	13726	196.15	0.0008
Error	3	209.93371	69.97790		

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Corrected Total	4	13936			

Root MSE	8.36528	R-Square	0.9849
Dependent Mean	1133.75600	Adj R-Sq	0.9799
Coeff Var	0.73784		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	-73335	5317.12203	-13.79	0.0008
Rok	1	37.04900	2.64533	14.01	0.0008

Source: own processing

We conducted a similar analysis for tracking trends in expenditures from public funds on research. In this case, we found that the observed expenditures increase annually by about 41 million EUR. This model presents the relatively high degree of confidence in respect of the mentioned variables. It should also be pointed out that this is the time interval in which the economic crisis was fully reflected and therefore expenditures on research and development from public funds could be negatively affected, which linear regression model does not confirm. Thus we can say that the impact of the economic crisis in this case is negligible, respectively; there was no reversal of previous development.

Table 6  
Linear regression model of Expenditures from public funds

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	17412009473	17412009473	34.80	0.0097
Error	3	1501096788	500365596		
Corrected Total	4	18913106261			

Root MSE	22369	R-Square	0.9206
Dependent Mean	239301	Adj R-Sq	0.8942
Coeff Var	9.34756		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	-83633376	14218045	-5.88	0.0098
Rok	1	41728	7073.65249	5.90	0.0097

Source: own processing

In doing so, based on the results of the work of other authors (Bogliacino - Pianta, 2010; Ejermo - Kander - Henning, 2011), we find that expenditures on research and development in relative terms should either be constant, considering the level of GDP per capita or positively dependent. The argument is also confirmed in this case, where there is the existence of a strong positive correlation between the relative amount of expenditures on research and development towards level of GDP and relative GDP per capita.

Table 7  
Correlation matrix (Pearson Correlation Coefficient)

Pearson Correlation Coefficients, N = 5 Prob >  r  under H0: Rho=0		
	GDE_on_RD_%	GDP_per_capita
GDE_on_RD_%	1.00000	0.91798
		0.0279
GDP_per_capita	0.91798	1.00000
	0.0279	

Source: own processing

This fact can be shown also graphically where we identify a clear linear development of relationship between these variables. Width of the prediction interval is large because of the low number of paired measurements, which is increased by this indicator. In the case of a higher number of measurements, there would occur narrowing of the width of this interval (ellipse).

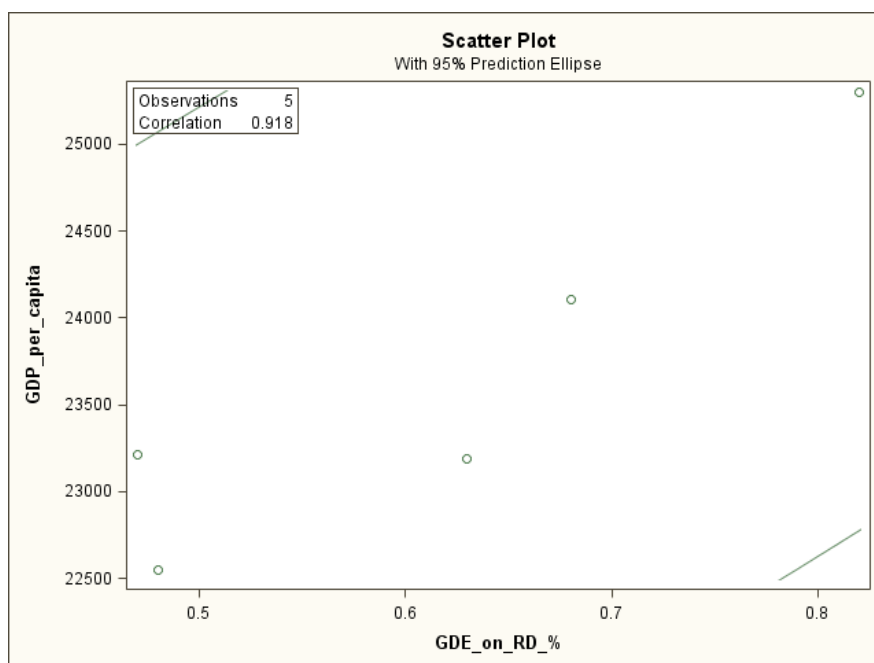


Figure 3  
Scatter Plot  
Source: own processing

On this basis, we can assume that in case of the growth of GDP per capita relative increase in the level of expenditure on R&D to the total volume of GDP occurs. Therefore, we can assume that economic development supports the development of research and development. It is yet possible to identify in the works (Fu - Gong, 2011; Meo et al., 2013).

## Conclusion

Slovak Republic in comparison with the EU27 is below average in innovation performance evaluation. As a preventive measure Slovakia approves Innovation Strategy, which the government approved in March 2007 (Innovation Strategy of the Slovak Republic for the years 2007-2013), in February 2008 (Innovation Policy of the Slovak Republic for 2008 to 2010) and the Innovation Policy for 2011 - 2013. The latest issued material is Innovation Strategy for 2014 - 2020. It is based on documents as National Strategic Reference Framework of the Slovak Republic for 2007 - 2013, Innovation Strategy for the Slovak Republic for the years 2007-2013, Europe 2020, the EU Program Horizon 2020, and Program Declaration of the Government for the years 2012 - 2016. The main objective of the document is, as in previous years, to identify activities and tools supporting innovation activities by central government bodies financed by national public funds and Structural Funds in the programming period 2014 - 2020. The strategic objective of the Innovation Strategy SR of 2020: „The strategic objective is to improve the ability to commercialize and adopt innovation and technology and to rank Slovakia among successful industrialized countries of the 21st century. Doubling the share of expenditure by enterprises on innovation made based on the results of research and development activities. The result of this strategy is to improve the position of SR by 5 places in the innovation performance characterized by SII“ (Innovation Strategy, 2012).

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# APPLICATIONS OF MODELS IN PREDICTING THE FINANCIAL DEVELOPMENT OF ENTERPRISE IN SLOVAK REPUBLIC<sup>1</sup>

*Adela SLIVKOVÁ - Edita MILČEVIČOVÁ*

## **Abstract**

Overall rating indexes represent the general characteristics of financial situation and performance of the business. Predictive models have to inform whether enterprise is under the threat of bankruptcy in the near future. Those were derivatives from the real data of the businesses that have gone bankrupt or on the contrary were prospering.

This work is devoted using multivariate discriminates analysis models namely Altman's confidence index and the index IN. In order to calculate those indexes we have used data from the financial reports of the Vetropack Nemšová Ltd. company for the period 2005 - 2010.

## **Keywords:**

Models of bankruptcy, site models, theory of bankruptcy, theory of financial health, Altman confidence index, index IN

## **Introduction**

Financial analysis represents important part of the management of the enterprise. It has a key position in the assessment of the actual situation of the company and moreover it also shows certain effort in terms of prediction of company development in future. Financial analysis during its existence has developed extensive framework of standardized methods that can assess financial health of the business.

In the present times, it became inevitable in terms of financial control of the business needs for not only financial mathematic but also mathematical-statistical and quantitative methods.

## **1. Models of prediction of financial development of the enterprise**

The objective of models of prediction are besides of reviewing and picturing the situation in enterprise also ability to draw attention to a future and moreover effort in a prediction in terms of future business development. The models of prediction are mostly divided as a bankruptcy models and site models, which are aiming to evaluate credit of the enterprise and eventually predict the bankruptcy or recognise the stage of liability.<sup>2</sup> Bankruptcy and site models are believe to be also divided by nature of the information which helps investor as well as creditors whether to get involved in such a business. From the business point of view it's more suitable to divide the mathematical method used with particular models:

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<sup>1</sup> This paper is part of the project Young scientists no. 2330262 - PERFECT (PERFORMANCE & EFFICIENCY INDICATORS)

<sup>2</sup> KOTULIČ, R.: Financial analysis of enterprises. Bratislava : Iura Edition, 2007, 206s., ISBN 978-80-8078-117-0, s. 110.

Linear discriminant analysis,  
Multiply discriminant analysis,  
Scored method.

The article expresses the application of the models of multiply discriminatory analysis, in particular Altman's model and index IN.

## 2. Models of multiply discriminant analysis

Shows the models where different scales are assigned to elementary characteristics based on different types of tests. These tests need appropriate editing of individual weights that vary over time, and depending on the industries in which the enterprise operates. Aim of these models is ability to predict the financial situation using results and classify the enterprise into a category of prospering or not prospering businesses.

In multiply discriminant analysis we can find many of the models that are trying to forecast the financial problems of the enterprise. In an article we are going to focus on Altman's models and indexes IN.

### Altman's Model

Arose in 1968 in United States and has been named by Professor Edward Altman. In a literature has been very often known as an Altman's text, Altman's index of credibility or Z – score. Altman has been analyzing 66 companies and has chosen them matching two groups – first was right before the bankruptcy and the other ones well prospered. Multiply discriminant analysis he has created scales of individual indexes and define attributes for classifications of businesses into a three groups. He is predicting the financial development of the company till the risk of bankruptcy.<sup>3</sup>

Altman finds out that the best indexes to predict the financial situation of the company were:

- x1 – net working capital/total capital,
- x2 – accumulated profit/ total capital,
- x3 – before tax income + interests/ total capital,
- x4 – market value of equity/liabilities,
- x5 – revenue/ total capital.

Altman has created discriminatory function for companies in form:

$$Z = 1,2x_1 + 1,4x_2 + 3,3x_3 + 0,6x_4 + 1x_5$$

Financial situation of the enterprise is measured through this equation and specifies three zones for future prediction. If is<sup>4</sup>:

**$Z > 2,99$**  the financial situation of the enterprise is very well

**$1,81 < Z < 2,99$**  area of nondescript result (grey zone), possibility of bankruptcy

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<sup>3</sup> ALTMAN, E.I.: Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. In: *The Journal of Finance*, Vol. 23, No. 4 (Sep., 1968), pp. 589-609.

<sup>4</sup> ALTMAN, E.I.: Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. In: *The Journal of Finance*, Vol. 23, No. 4 (Sep., 1968), pp. 589-609

$Z < 1,81$  the financial situation is critical, bankruptcy is most likely to happen

Companies which were classified into the third group are very likely to end up bankrupt, whether companies in the first group does not have financial troubles and companies in the middle zone has to be monitored as they can gone both directions. Altman's model shows that the prediction of bankruptcy for company is effective on two years in advance with a probability approximately of 70 per cent for the period of five years.

## Index IN

Additional alternative how to evaluate financial health of the company through models of bankruptcy and site models is index IN. Through those models we can determine with some probability if company falls under bankruptcy or site and whether is able to create some profit for its owners. There are few Indexes IN however those are not named by the year of creation. Namely indexes IN95, IN99, IN01, IN05 that were found by Inka and Ivan Neumaier.

Index IN95 is first version Czech index. Index has been created from 6 indicators with a relevant importance. Index IN95 arose in 1995 based on the information achieved in 1994. Data was gathered and processed for industry itself as well as for particular segments. Success of this index is more than 70 per cent.

$$\begin{aligned}
 IN95 = & 0,22 * \frac{\text{assets}}{\text{borrowed capital}} + 0,11 * \frac{EBIT}{\text{interest expensies}} + 8,33 \\
 & * \frac{EBIT}{\text{assets}} + 0,52 * \frac{\text{returns}}{\text{assets}} + 0,10 \\
 & * \frac{\text{current assets}}{(\text{current liabilities} + \text{short term financial assistance})} \\
 & - 16,8 * \frac{\text{liabilities after due of payment}}{\text{returns}}
 \end{aligned}$$

Intervals of index IN95<sup>5</sup>:

IN95 < 1 enterprise in financial difficulty

IN95 = 1 - 2 grey zone

IN95 > 2 enterprise without any financial problems

This index is focused on company's ability to pay its liabilities, it did not deal with the requirements of the owners to create value for business owners. This aspect is taken into

<sup>5</sup> Financial analysis. [online]. [20. 10. 2011] Available on internet at: <[http://www.vision.cz/is-vision32/mis/chap\\_246/financni-analyza.aspx](http://www.vision.cz/is-vision32/mis/chap_246/financni-analyza.aspx)>.

account in the next index - IN99. Emphasizes the view of the owner and that is the reason that the index weights are modified IN95. Index IN99 has the form:

$$IN99 = -0,017 * \frac{assets}{borrowed\ capital} + 4,573 * \frac{EBIT}{assets} + 0,481 * \frac{returns}{assets} + 0,015 * \frac{current\ assests}{(current\ liabilities + short\ term\ financial\ assistance)}$$

Values<sup>6</sup>:

IN99 < 0,684 enterprise does not create value for business owners,  
 0,684 ≤ IN99 < 1,089 enterprise rather does not create value for business owners,  
 1,089 ≤ IN99 < 1,420 it is not possible to determine whether the enterprise is the value for the owners - a gray zone,,  
 1,420 ≤ IN99 < 2,070 enterprise rather creates value for business owners,  
 IN99 ≥ 2,070 enterprise does create value for business owners.

Index IN99 is recommended in cases where it is not possible to determine the cost of equity capital to calculate EVA. The Access of index IN99 is estimated at more than 85%.

In year 2000, the authors of the IN95 and IN99 decided to construct the index, which combines features of both previous indices and it would evaluated the company's ability to meet their obligations and to create value for owners of the company. Using discriminant analysis, the authors came to the equation IN01 which was applied to industrial enterprises and has the following form:

$$IN01 = 0,13 * \frac{assets}{borrowed\ capital} + 0,04 * \frac{EBIT}{interest\ expansies} + 3,92 * \frac{EBIT}{assets} + 0,21 * \frac{returns}{assets} + 0,09 * \frac{current\ assets}{(current\ liabilities + short\ term\ financial\ assistance)}$$

Intervals of index<sup>7</sup>:

IN01 < 0,75 enterprise goes to bankrupt,  
 0,75 < IN01 < 1,77 grey zone,  
 IN01 > 1,77 enterprise creates value for owner.

<sup>6</sup> KOTULIČ,R., KIRÁLY,P.,RAJČÁNIOVÁ,M.,: Financial analysis of enterprise. No.1. Bratislava, Vydavateľstvo Iura Edition, 2007, 206 strán. ISBN 978-80-8078-117-0

<sup>7</sup>KOTULIČ,R., KIRÁLY,P.,RAJČÁNIOVÁ,M.,: Financial analysis of enterprise. 1.vyd. Bratislava, Vydavateľstvo Iura Edition, 2007, 206 strán. ISBN 978-80-8078-117-0

Merits of the index IN01 is smallest time restrictedness. However it is important to bring to the mind that those indexes has got only informative character thus it should not be used instead of financial analysis in the enterprise.

Another index is IN05 which helps the evaluator to get an overview of the business performance. In the article we are going to examine this index and the system of its application as well as characteristics of the business performance based on the result achieved by this index using and data form annual reports.

Index IN05 is created by 5 indicators. Two of them refer to the ability of the business to create profit and two of the others show the method of melon-cutting before interest and taxes. Scales that are assigned to the individual indicators were determined by authors of the index, Neumaier through the discriminatory analysis.<sup>8</sup>

$$\begin{aligned}
 IN05 = & 0,13 \times \frac{assets}{borrowed\ capital} + 0,04 \times \frac{earning}{interest\ expansies} + 3,97 \\
 & \times \frac{earning}{assets} + 0,21 \times \frac{returns}{assets} + 0,09 \\
 & \times \frac{current\ assets}{current\ borrowed\ capital}
 \end{aligned}$$

These calculative values of index IN05 then divide companies into individual intervals. Based on these calculations it is possible to predict future development with high probability in the company.

The boundaries for the classification of companies:<sup>9</sup>

IN05 < 0.9 enterprise goes bankrupt,

IN05 ≤ 0.9 < 1.6 is located in the gray zone,

IN05 ≥ 1.6 site company.

User can answer a few questions by using the index IN05. For example whether the enterprise is or is not site business or it is not possible to classify it to class with sufficient probability it cannot be assigned to either one of these groups, which ultimately means that the company may incline to one or the other alternative in its further existence.

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<sup>8</sup> VOCHOZKA, M. *Methods for evaluation of complex business*. Praha : Tiskárny Havlíčkov Brod, 2011. ISBN 978-80-247-3647-1. [online]. [18. 10. 2011] Available on internet at: <[http://books.google.sk/books?id=DZC0YIMqH4MC&printsec=frontcover&source=gbs\\_ge\\_summary\\_r&cad=0#v=onepage&q&f=false](http://books.google.sk/books?id=DZC0YIMqH4MC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false)>.

<sup>9</sup> NEUMAIEROVÁ, I.; NEUMAIER, I. *Index IN05. European financial systems, Proceedings of the International Scientific Conference*. Brno : Masaryk University in Brno, 2005. p. 143-146. [online]. [21. 11. 2011] Available on internet at: <<http://is.muni.cz/do/1456/sborniky/2005/evropske-financni-systemy-2005.pdf>>.

As the index has been used for many years in practice it is possible to talk about its advantages, which include, among others, that the calculation realized by this index is simple, algorithm of financial coefficients represented in the model are transparent, publicly available financial data of enterprise are used, the index is possible to use for tradable and non-tradable enterprises on the capital markets. This index was created for the conditions of enterprises in the Czech Republic, which are largely similar to those in Slovakia. Items contained in the statements of enterprises in the Czech Republic and Slovakia are similar, so it is possible to find all the information needed to calculate the index in the balance sheets and statements of enterprises in the Slovak Republic. Index IN05 results are clear. This index is suitable as a part of various economic analyzes of business situations. Index IN05 removes subjectivity in the selection of indicators and their significance.

The disadvantages of the index are following: it summarizes the state of enterprise into a single number, which prevents detection of where the company has problems and thus makes it impossible to establish options to eliminate these problems.

The index was created and tested mostly with data of large and medium industrial enterprises and, therefore, it has the best explanatory ability just for these companies.

Another important fact which is needed when the model is used that it is working with data, which are denominated in a term of one year, that is an expression of business performance for the year.

### **3 Using the bankruptcy indexes in the selected company**

The data necessary to calculate the Altman's index of confidence and IN05 index are drawn from the accounts of the enterprise Vetropack Nemšová Ltd. for the period 2005 - 2010.

VETROPACK NEMŠOVÁ s.r.o. is a subsidiary of the Swiss Vetropack Holding AG, a leading European manufacturer of glass packages in Europe since 2002. Vetropack Glass works are also in Switzerland, Austria, Croatia, Czech Republic and recently in Ukraine. Vetropack Nemšová Company Ltd. is the largest producer of glass containers in Slovakia. Every year they sold over 450 million units and about 40% of production goes abroad. The range includes in addition to glass bottles also canning glass, glass packages of baby food, ketchup, instant coffee, and many others, especially food products.

Table no. 1 shows the data from the statements of finances of the enterprise Vetropack Nemšová Ltd. for the period 2005 - 2010, which are necessary to calculate the Altman's confidence index and IN05 index.

Table 1

**Data from the statements of finances of the enterprise Vetropack Nemšová Ltd. For period 2005 - 2010 in EUR**

	2005	2006	2007	2008	2009	2010
asset	49 005 743	69 337 483	64 385 182	73 585 773	70 024 469	67 602 487
inventory	7 823 043	8 590 420	9 492 631	10 422 326	10 328 168	8 349 889
receivable	8 233 121	9 648 609	8 284 638	9 307 641	9 678 882	10 070 137
money	21 576	24 298	19 186	11 384	13 047	10 144
current liabilities	3 898 958	10 459 636	6 066 620	8 285 335	4 151 418	14 190 299
accumulated profits	517 194	368 0708	868 1803	11 085 308	15 325 005	15 942 336
gross profit	3 519 584	5 553 973	4 246 863	7 811 890	2 587 182	3 324 459
interest expenses	741 021	953 064	1 456 582	1 284 374	619 395	430 626
Equity	20 572 894	25 837 184	29 632 211	35 124 676	34 950 423	35 875 594
liabilities	4 039 634	10 811 425	6 771 261	9 890 029	11 394 652	17 501 584
Revenue	22 932 284	24 775 675	22 644 858	25 451 238	19 187 942	16 936 276
Borrowed capital	22 015 502	29 027 584	25 665 073	25 089 325	21 220 000	11 250 000
income	47 011 850	51 612 926	54 180 608	58 518 556	48 787 680	48 700 534
current assets	21 048 928	20 767 842	19 715 893	22 646 086	21 001 313	21 911 186

Source: own processing

To determine the risk that a financial firm goes bankrupt, we use Altman's confidence index, which is adapted for companies non-tradable on the exchange stock. Based on data from the annual report of the company the Altman's confidence index was calculated for the years 2005 - 2010 in the company Vetropack Nemšová Ltd.

Table 2

**The Altman confidence index**

Year	2005	2006	2007	2008	2009	2010
x1	0,248517	0,112546	0,182182	0,155682	0,226616	0,062718
x2	0,010554	0,053084	0,134842	0,150645	0,218852	0,235825
x3	0,086941	0,093846	0,088583	0,123614	0,045792	0,055547
x4	5,092762	2,389804	4,376173	3,551524	3,067266	2,049848
x5	0,467951	0,35732	0,351709	0,345872	0,274018	0,250527
The Altman's confidence index	<b>4,12</b>	<b>2,31</b>	<b>3,68</b>	<b>3,28</b>	<b>2,84</b>	<b>2,07</b>

Source: own processing

The Table 2 shows data of Altman's confidence index for the years 2005 - 2010. For a better view of the development of Altman's confidence index in the company Vetropack Nemšová Ltd. data are shown by Figure 1.

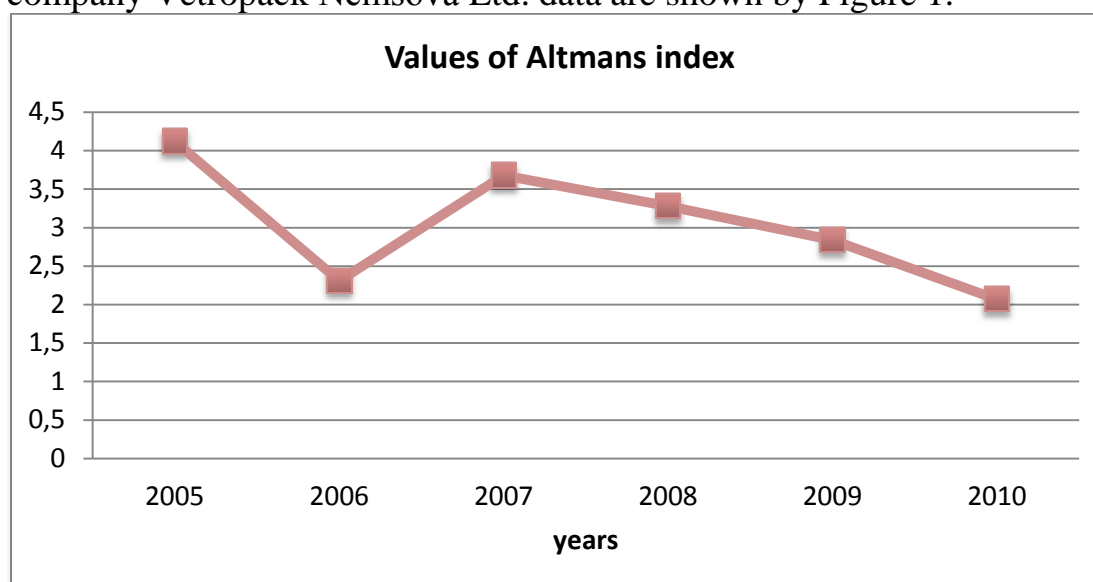


Figure 1

**Development of the Altman's index in company Vetropack Nemšová Ltd.**

Source: own processing

In 2005, 2007 and 2008 values were obtained over 2.99. In terms of Altman's analysis we can evaluate the company Vetropack Nemšová Ltd. as healthy and without any prospect of bankruptcy in the future.

In recent years, t. j. 2006, 2009 and 2010, the Altman index value is Loir and in these years enterprises falls into a gray zone. The situation in the company is also affected by negative developments, such as growth of loans. It is recommended to monitor this indicator more especially in the following years to prevent its collapse and the threat of a possible bankruptcy of the company.

The following table shows the calculated data recorded in the index IN05 years 2005 - 2010 in the company Vetropack Nemšová Ltd.

Table 3



### Values of IN05 index in enterprise Vetropack Nemšová

Index IN05	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009	Year 2010
	1,35	1,23	1,07	1,46	1,34	1,58

Source: own processing

Table of calculation of IN index shows that business in all analyzed years is taking place in "Gray zone", so it is not possible with a sufficient degree of probability determine whether the company in subsequent periods will be able to create value for its owners and meet their obligations or if it will go to the bankrupt. From 2005 to 2010 the activity of enterprise performance was stable, reaching values in the interval of  $0.9 \leq \text{IN05} < 1.6$ . In this case it is not possible to take a decision about next behavior of the corporation only according to results of the index. It is necessary to realize additional analyzes by which the management company could make responsible decisions about the next functioning of the enterprise.

In specific cases, some companies may be that the balance sheet or profit and loss statement of enterprises do not have the data necessary to calculate the index IN05 or the statements do not include some of the items needed for the calculation of the index. In such cases, the authors in a given index recommend to replace values of indicators by theirs maximum values. For instance, in some companies the situation when enterprise is not creating interest expenses can take place, which means that business hasn't got payment obligation against banks, suppliers due to a interests based on loans they got. It can lead to inaccurate results in case of variable income / interest expenses. To resolve the situation, the authors recommend to replace the value of this coefficient by maximum value of 9. That restrain from it, so in case of incorrect calculation of one of the indexes, inaccurate findings will not influence the overall picture of financial health of the business.

### Conclusion

Currently, continuous, rapid and sometimes non-recurring changes in the economy with far-reaching and in some cases even irreversible consequences is very important for the members of the management company's to know financial situation and to choose the most appropriate strategy for its further operation. One of the ways to assess the financial health of business is site and bankruptcy models. In the article we explains how selected models of this group use to analyze financial data of enterprises and how to correctly interpret them so the right decision can be make.

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# OUTSOURCING IN THE CONTEMPORARY ECONOMY. THEORY AND PRACTICE WITH PARTICULAR FOCUS ON THE GROUNDS OF OUTSOURCING ACCOUNTING SERVICING

*Katarzyna ŚWIETLA*

## **Abstract**

As the economy grows, it requires increasing specialization of its participants. At the same time, in order to preserve a market position, it is necessary for the entities operating under its influence to focus on their key processes. The fulfillment of these conditions is increasingly possible thanks to outsourcing their certain functions (which are not for key operations) to external entities. This applies to accounting, which is a field that requires extensive knowledge and practical experience, as well as the use of complex, modern systems of operation. In addition to the practical considerations, the study shows a correlation between the cost of purchasing external accounting services and an on-time employment of an accounting specialist.

## **Keywords:**

outsourcing, accounting, costs, services

## **Introduction**

The world economy is constantly changing. Beginning with the twenty-first century, we have observed its increased complexity and unpredictability, which must be taken into account by economic operators today. This variability is derived from the expectations of customers as well as from new, innovative technologies that improve the speed and scope of the information flow. Operators are, therefore, facing the daily confrontation of their capabilities with the needs of the market.

Providing high-quality activities in all areas is becoming more difficult and expensive, at the same time, it often does not allow for the proper execution of an operator's key feature. In this situation, enterprises are increasingly recognizing the need to focus on their core business as indicated by B. Nogalski (2010). This approach has long promoted the dissemination of the concept of outsourcing across the economy, which involves the transferring specific areas of activities to external entities. By designating certain functions or processes, business units can focus on their core objectives that determine their performance and thus their market value.

For an effective implementation of outsourcing it is necessary, however, to understand its definition, principles of operation and areas of use. Also, the ability to assess the advantages and disadvantages is of importance, which will form the basis for the decision to move a particular process outside of the enterprise and subsequently monitor it skillfully from the point of view of the expected benefits.

The aim of the study was an attempt to define the concept of contemporary outsourcing of services in the background of the literature, together with an indication of relevant research areas. The financial advantages and disadvantages were also presented, along with the possibility to assess them on the basis of income and expense. In the empirical part, the author has analyzed the profitability of purchasing accounting services against the cost of hiring an employee, in relation to the price of a service that serves a similar range of activities. The analysis of other benefits or risks is not included, as they are difficult to estimate clearly due to the variety of expectations of specific individuals, and thus their subjective assessment.

## 1. Outsourcing in the contemporary economy

For years, specialization has been regarded as the key to success. This applies both to individuals and companies in which employees are professionals in the field. The quality and range of their activities, in addition to their knowledge, experience and skills, is certainly affected by modern technologies to support the functions performed. At the same time, the multidimensional nature of the modern economy is noted, forcing the simultaneous specialization of entities in various functional areas.

Ensuring the expected dimension of handling complex processes to the needs of maintaining a market position is becoming increasingly difficult, among others, due to the cost and time consumption. In this situation, the increasingly popular outsourcing of sought after services is becoming the solution which allows for preserving the quality of services while reducing costs and saving time.

Table 1.

### Outsourcing, an attempt at a definition

Author	Definition
The Basel Committee on Banking Supervision.	A regulated entity's use of a third party (either an affiliated entity or within a corporate group or an entity that is external to the corporate group) to perform activities on a continuing basis that would normally be undertaken by the regulated entity,
M. F. Greaver	"The act of transferring some of a company's recurring internal activities and decision rights to outside providers, as set forth in a contract" in order to focus on the company's unique resources (key competencies) in order to lead its specialized operations,
Ch. L. Gay, J. Essinger	Outsourcing, considered from a strategic perspective, today is one of the most

D. Lei, M. Hitt	important business approaches that confers the greatest benefits, as it allows organizations of all types to make full use of their potential and achieve optimal efficiency and flexibility to respond to customer needs, Outsourcing is a business cooperation with external suppliers in the production of components and other operations of high quality
P. Doyle	Outsourcing generally allows companies to replace fixed costs with a variable spread over a longer period,
W. T. Bielecki	Ordering certain services and tasks from external companies specialized in the field
J. Penc	Outsourcing is the use of complex services, which are a combination of a variety of partial services sold and settled as a unit and they offered by external contractors (tenders)
M. Trocki	Outsourcing is a project that involves the separation of certain function of the parent organization and performance and transferring their implementation to other operators,
I. Sobańska	Outsourcing is a specific type of decision on the elimination of certain operations for the organization, or services that do not contribute to the growth of the company and its competitive position,
K. Perechuda	The ability to opt out of the development of specific areas within the parent company through the use of resources of external actors,
B. Liberska	Outsourcing involves the allocation, from a parent entity, of some of the previously performed services (processes) related to customer service and transferring them to an external entity that provides them at lower production costs.

Source: Own, based on: *Outsourcing In Financial Services*, The Joint Forum, Basel Committee on Banking Supervision, Bank For International Settlements, February 2005, p. 4, M. F. Greaver, *Strategic Outsourcing. A structural Approach to Outsourcing Decisions and Initiatives*, Amacom, New York, USA 1998, p. 91, Ch. L. Gay, J. Essinger, *Outsourcing strategiczny*, Oficyna ekonomiczna, Kraków 2002, p. 7, D. Lei, M. Hitt, *Strategies restructuring and outsourcing: the effect of mergers and acquisitions and LBOs on building firm skills and capabilities*, Journal of Management, vol.21, No. 5, 1995, s.835, D. P. Doyle, *Kontrola kosztów, Element zarządzania strategicznego*, Oficyna Ekonomiczna, Kraków 2006, p. 57, W.T. Bielecki, *Informatyzacja zarządzania*, PWE, Warszawa 2001, p. 192, J. Penc, *Leksykon biznesu*, Placet, Warszawa 1997, p. 302, M. Trocki, *Outsourcing. Metoda restrukturyzacji działalności przedsiębiorstw*, PWE, Warszawa 2001, p.13, *Rachunek kosztów i rachunkowość zarządcza*, Ed. I. Sobańska, C.H.Beck, Warszawa 2003, p. 415, K. Perechuda, *Zarządzanie przedsiębiorstwem przyszłości. Koncepcje, modele, metody*, Agencja

The concepts of outsourcing are also characteristic of Business Process Reengineering (BPR) and Lean Management. In the first case, it is expected to improve the expected performance in a clearly noticeable and even downright leaping manner. Outsourcing is considered to be an ancillary activity of a non-basic character conveyed by external entities. The second approach seeks to adapt the company to the market economic conditions by the gradual transformation of the organization and its functioning. In this sense, outsourcing is treated as a long-term partnership where the most important suppliers are involved in the implementation of the key tasks of innovation (Hammer, Champy 1999).

It is important, however, to separate the processes for handling external entities do not include the basic activities for which the entity was established. As K. Obłój (1999) states, outsourcing of key competences is suicidal, just like the lack of knowledge about what is the key competence of the entity. It follows that the key to make an informed decision is to determine the areas of the use of outsourcing in practice, taking into account the needs and expectations of the customer.

## 2. Areas of interest in outsourcing

According to the author, studies on outsourcing are usually performed in four main perspectives:

- Towards a generalized indication of its objectives, principles and directions for use,
- Presentation of the practical use of relocated services in specific industries,
- Demonstration of its use in certain countries,
- Focus on a specific group of services (e.g. accounting, IT).

Below, in Table 2, a sample of studies to confirm the thesis adopted by the author is found.

Table 2.

### Content overview of selected publications in the field of research on outsourcing

Direction of research	Author	Subject matter
Aims, principles and areas of using outsourcing	S. M. Bragg	Outsourcing strategies, its key functions, outsourcing of functions,
	N.C. Burkholder	The functions of outsourcing, advantages and disadvantages, political considerations and the impact on the labor market,
	T. Kopczyński	An indication of the place of outsourcing among the modern management concepts, its

<p>Practical use in selected industries</p> <p>M. F. Corbett</p>	<p>essence for the process and prospects of development in developed countries and in Poland,</p>
<p>H. Lewandowska</p>	<p>Apart from identifying the history, development and new concepts in outsourcing and its disciplines, the study included the use of outsourcing in practice in selected entities (Aetna, Campbell Soup Company, Computer Sciences Corporation, and others),</p>
<p>A. Korzeniowska</p>	<p>The analysis of outsourcing in health care,</p>
<p>Outsourcing in comparison with other countries</p> <p>R. Hira, A. Hira</p>	<p>An indication of the use of outsourcing in commercial banks in order to reduce costs and achieve competitive advantage, along with access to modern technology and the improvement of quality of services,</p>
<p>Chillibreeze report</p>	<p>The authors draw our attention to difficulties in the U.S. labor market as a result of exploration of cost reductions (cheap labor) by companies, through outsourcing of operations.</p>
<p>Outsourcing of a chosen service</p> <p>T. Olavi Bangemann</p>	<p>The report is based on information coming from the Middle East, with particular emphasis on India as a business location of accounting centers, indicating both the advantages of locating financial centers in India and on the background of the constant growth in turnover in the field,</p>
<p>S. M. Bragg</p>	<p>the presentation of the role of shared services centers for accounting and finance, their anatomy, and principles of cooperation with them, along with advantages and disadvantages,</p>
	<p>The study pointed out the advantages and disadvantages of outsourcing accounting services outside the organization to reduce costs and improve quality, and focused on the rules of management of this process.</p>

source: Own, based on: S. M. Bragg, *Outsourcing A Guide to: Selecting the Correct Business Unit, Negotiating the Contract, Maintaining Control of the Process*, J.Wiley & Sons Inc., USA, New York 2006, N. C. Burkholder, *Outsourcing, The Definitive view, Applications and Implications*, JohnWiley & Sons Inc., Hoboken, New Jersey, USA 2006, T. Kopczyński, *Outsourcing w zarządzaniu przedsiębiorstwami*, PWE, Warszawa 2010, M. F. Corbett, *The Outsourcing Revolution, Why It Makes Sense And How To Do It Right*, Dearborn Trade Publishing, USA 2004, H. Lewandowska, *Outsourcing, Model zarządzania w podmiotach sektora ochrony zdrowia*, Difin, Warszawa 2010, A. Korzeniowska, *Outsourcing w bankach komercyjnych*, Difin, Warszawa 2009, R. Hira, A. Hira, *Outsourcing America, The true cost of shipping jobs overseas and what can be done about it*, Amacom, New York, USA 2008, T. Olavi Bangemann, *Shared Services in Finance and Accounting*, The Hacket Group, England, London 2005, *Legal Process Outsourcing and Accounting Outsourcing to India*, India Reports, A Chillibreeze Publication, India, October 2009, S. M. Bragg, *Just-inTime*



According to the trends prevailing in the global markets, moving specific areas of operations to be handled by external bodies is becoming increasingly common. It is also facilitated by the development of data transfer technologies. Thanks to communications technologies, relocation of services can occur in three ways:

- To one's foreign branches,
- Two independent foreign entities (McIvor 2010),
- And to a national external entity.<sup>10</sup>

For the realization of the objective established by the outsources, the selection of the method of moving operations out of the company is crucial, as it will ensure the maximization of the benefits while minimizing the potential arising risks. It must be stressed that the increasing use of outsourcing in different countries, industries and disciplines require an analysis of the potential benefits and risks arising from it (especially financial ones).

### **3. Parameters for assessing the use of outsourcing in practice**

The widespread positive attitude towards outsourcing is the result of the perception of its many advantages, particularly financial ones. Most point to the possibility of limiting the costs of operation of the outsourced function under resulting both from the purchase of only the amount of action that is necessary, and from the use of modern technology without the need to invest in it. This facilitates the access to expertise offered by the service provider's staff and allows the organization to limit its spending on employment or is conducive to moving them to the departments which are the backbone of the core business.

The perceived benefits are the result of the implementation of expectations depending on the entity's policy. At the same time, the organizations undertaking (especially the first time) decisions about the use of outsourcing express concerns about its justification, seeing its many flaws. The concern is often raised as to the confidential information being transferred to an external body, and the possible inability to withdraw from the contract (e.g. penalties, loss of the ability to handle an already commissioned process). S. D. Brown and S. Wilson define basic financial advantages and disadvantages as presented in Table 3

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<sup>10</sup>This method of relocation was analyzed in the empirical part of the study.

Table 3.

### Financing advantages and disadvantages of outsourcing

#### Advantages

- Access to the latest technology without the need for capital investment,
- Time-saving for managers.
- Smooth cash flows to perform the assigned tasks,
- Reduction of wage costs and the necessary equipment,

#### Disadvantages

- Lack of modern solutions offered by the outsourcer,
- Need for costly control over the quality of performing tasks,
- Obstacles to change the service provider or take over a dedicated action back to the company's structure due to the high costs,
- High contract costs and limitations of introducing changes,

Source: Own, based on: D. Brown, S. Wilson, *The Black Book of Outsourcing. How to Manage the Changes, Challenges and Opportunities*, John Wiley & Sons, Inc, New Jersey 2005 p. 54.

Among the advantages and disadvantages, the most obvious ones are the issues of income and costs of outsourcing. For the purposes of the evaluation, it is favorable to maintain an ongoing monitoring of costs and revenues, as well as the final accounts, which shall allow for an accurate determination and evaluation. For these purposes, it may be helpful to use the following simple cost-benefit analysis for the undertaken projects (Millgram, Roberts 1994):

$$\sum \Delta P_{in} - \sum \Delta K_{in} > 0 \quad (1)$$

$\sum \Delta P_{in}$ - the sum of the changes in revenue in “i” areas of the enterprise as a result of outsourcing.

$\sum \Delta K_{in}$ - the sum of the changes in costs in “i” areas of the enterprise as a result of outsourcing.

On the basis of this formula it should be determined whether the change in the revenue achieved after outsourcing services exceeds the cost of its implementation. If the value is positive, then one should also check the following:

$$\sum_0 P_{in} - \sum_0 K_{in} > \sum_p P_{in} - \sum_p K_{in} \quad (2)$$

$\sum_0 P_{in}$ - Total income in individual areas of the entity after the implementation of outsourcing,

$\sum_p P_{in}$ - Total revenue in individual areas of the enterprise operations prior to outsourcing services,

$\sum_0 K_{in}$ - Total cost in individual areas of the entity after the implementation of outsourcing,

$\sum_p K_{in}$ - Total cost in individual areas of the entity prior to the implementation of outsourcing,

These calculations will determine whether the difference between revenues and costs of operations are greater or smaller before and after the use of outsourcing and thus give an answer to the question about the legitimacy of moving the process outside.

For the purpose of the research, the relationship between cost of accounting services provided by an accounting office and the cost of hiring an employee were adopted. The cost of employing an accountant was treated as constant, while the price of services purchased from an accounting firm changed at intervals dependent on the number of documents processed or the number of employees for whom e.g. personnel management services were performed.

#### **4. Accounting service in-house or outsourcing?**

In the course of the study, the cost of employing a person in an accounting department in relation to<sup>11</sup> the cost incurred for the acquisition of external services were subjected to a comparative analysis.

The study was conducted with consideration to the size of cities, as the service range, the wages, and the service prices alike are often different depending on the size of the market. Prices of services were examined on the basis of offer found online and interviews conducted in person in accounting firms. On-time accountant salaries were analyzed on the basis of job offers found in the press and on the Internet – offered by employment agencies – and through personal interviews.

The cost of services purchased was established dependent on the accounting system (revenue and expense ledger/integrated accounts). Against this background, the amount of processed documents and the number of persons employed in the studied enterprises were considered, due to personnel and wage issues.

For the purpose of this discussion, the subject matter was presented by the means of the function  $f$  assuming the relationship between the amounts of invoices/documents - variable<sup>x</sup> the number of employees - variable<sup>y</sup>, and the cost of services:

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<sup>11</sup>The cost of employing a mid-level accounting professional was considered, as specialists at higher levels (auditors, tax advisors) achieve significantly higher incomes and often provide services through leading accountancy offices.

$$f(x, y) = \begin{cases} a_{11} & \text{dla} & x \in (0, n_1] \cap N, y = 1 \\ a_{12} & \text{dla} & x \in [n_1 + 1, n_2] \cap N, y = 1 \\ a_{13} & \text{dla} & x \in [n_2 + 1, n_3] \cap N, y = 1 \\ a_{14} & \text{dla} & x \in [n_3 + 1, n_4] \cap N, y = 1 \\ a_{15} & \text{dla} & x \in [n_4 + 1, +\infty) \cap N, y = 1 \\ \dots & \dots & \dots \\ \dots & \dots & \dots \\ \dots & \dots & \dots \\ a_{101} & \text{dla} & x \in (0, n_1] \cap N, y = 10 \\ a_{102} & \text{dla} & x \in [n_1 + 1, n_2] \cap N, y = 10 \\ a_{103} & \text{dla} & x \in [n_2 + 1, n_3] \cap N, y = 10 \\ a_{104} & \text{dla} & x \in [n_3 + 1, n_4] \cap N, y = 10 \\ a_{105} & \text{dla} & x \in [n_4 + 1, +\infty) \cap N, y = 10 \\ a_{151} & \text{dla} & x \in (0, n_1] \cap N, y = 15 \\ a_{152} & \text{dla} & x \in [n_1 + 1, n_2] \cap N, y = 15 \\ a_{153} & \text{dla} & x \in [n_2 + 1, n_3] \cap N, y = 15 \\ a_{154} & \text{dla} & x \in [n_3 + 1, n_4] \cap N, y = 15 \\ a_{155} & \text{dla} & x \in [n_4 + 1, +\infty) \cap N, y = 15 \\ a_{201} & \text{dla} & x \in (0, n_1] \cap N, y = 20 \\ a_{202} & \text{dla} & x \in [n_1 + 1, n_2] \cap N, y = 20 \\ a_{203} & \text{dla} & x \in [n_2 + 1, n_3] \cap N, y = 20 \\ a_{204} & \text{dla} & x \in [n_3 + 1, n_4] \cap N, y = 20 \\ a_{205} & \text{dla} & x \in [n_4 + 1, +\infty) \cap N, y = 20 \end{cases},$$

where  $N = \{1, 2, 3, \dots\}$ ,  $a_{ij}$  are the respective costs of services (presented in tables), and  $n_1, n_2, \dots, n_k$  are maximum values for the number of invoices/documents, at, respectively:

- $n_1 = 10, n_2 = 25, n_3 = 50, n_4 = 100$  (for Revenue and expense ledger)
- $n_1 = 20, n_2 = 50, n_3 = 100, n_4 = 200$  (for integrated accounts).

The study was performed in 2013. The values set in Polish zlotys have been converted into Euros at the exchange rate of 10/18/2013, which amounted to PLN 4.18 to 1 Euro.

For the study, the following assumptions were made:

Table 4

**Parameters used for the analysis**

city size	accountants' net annual earnings (averaged)	annual price of services (combined) (interval depends on the scope of services)
up to 100000 inhabitants	5454.55	652.39 – 6620.86
100,000 – 500,000 inhabitants	6315.78	694.25 – 8049.536
over 500,000 inhabitants	7177.03	765.66 – 9369.19
source: own		

Table 5

**Cost of services provided by an accounting office in a city with a population up to 100,000**

	Revenue and expense ledger					Full accounting				
documents/ Employees	up to 10	11 – 25	26 – 50	51- 100	100+	up to 20	21 - 50	51 – 100	101 - 200	200+
<b>1</b>	652.39 04	814.8 211	1050. 228	1282. 103	1641. 099	1627. 21	2105. 085	2703. 018	3543. 42	4741. 64
<b>2</b>	751.26 12	913.6 919	1149. 099	1380. 974	1739. 969	1726. 08	2203. 956	2801. 889	3642. 291	4840. 511
<b>3</b>	850.13 21	1012. 563	1247. 969	1479. 845	1838. 84	1824. 951	2302. 827	2900. 76	3741. 162	4939. 382
<b>4</b>	949.00 29	1111. 433	1346. 84	1578. 716	1937. 711	1923. 822	2401. 698	2999. 631	3840. 033	5038. 253
<b>5</b>	1047.8 74	1210. 304	1445. 711	1677. 587	2036. 582	2022. 693	2500. 568	3098. 501	3938. 903	5137. 123
<b>6</b>	1146.7 44	1309. 175	1544. 582	1776. 457	2135. 453	2121. 564	2599. 439	3197. 372	4037. 774	5235. 994
<b>7</b>	1245.6 15	1408. 046	1643. 453	1875. 328	2234. 323	2220. 434	2698. 31	3296. 243	4136. 645	5334. 865
<b>8</b>	1344.4 86	1506. 917	1742. 323	1974. 199	2333. 194	2319. 305	2797. 181	3395. 114	4235. 516	5433. 736
<b>9</b>	1443.3 57	1605. 788	1841. 194	2073. 07	2432. 065	2418. 176	2896. 052	3493. 985	4334. 387	5532. 607
<b>10</b>	1542.2 28	1704. 658	1940. 065	2171. 941	2530. 936	2517. 047	2994. 922	3592. 856	4433. 257	5631. 478
<b>15</b>	2036.5 82	2199. 012	2434. 419	2666. 295	3025. 29	3011. 401	3489. 277	4087. 21	4927. 611	6125. 832
<b>20</b>	2530.9 36	2693. 367	2928. 773	3160. 649	3519. 644	3505. 755	3983. 631	4581. 564	5421. 966	6620. 186

source: own

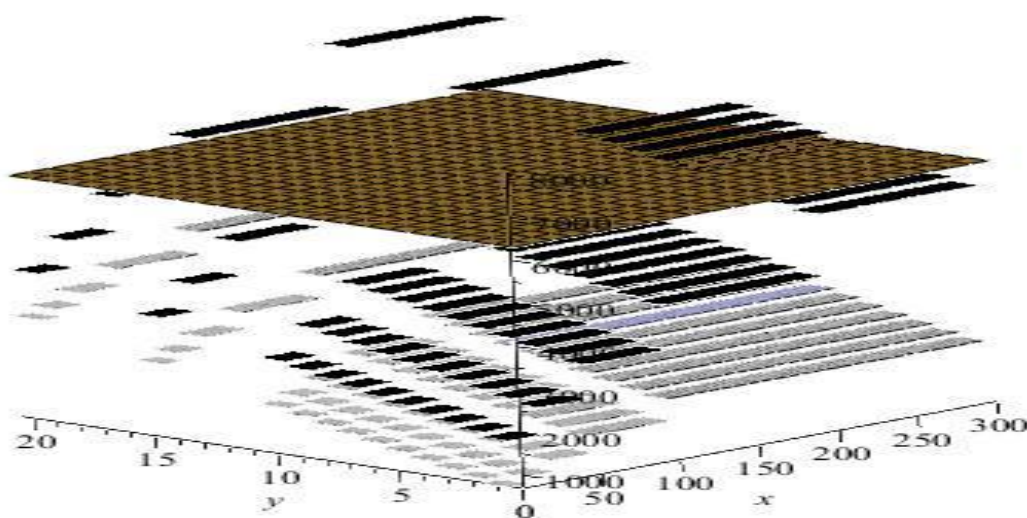
Tables 5, 6 and 7 present prices of purchased services that excess of the cost of hiring an employee in color.

First, prices of services in cities with the population less than 100,000 were analyzed and compared with the cost of hiring accountant's on-time.

It results from the statement presented in the table that accounting office's provide a wide price range without having to hire on-time employees, especially in small entities. Only in the case of medium-sized entities - employing at least 9 people, generating more than 200 documents and maintaining integrated accounts - a decision to hire an on-time accountant can be beneficial in terms of costs. This problem can be represented by the following functions:

Figure 1

**Distribution of the cost of accounting services relative to the cost of employing accountants in small-sized cities**



source: own

where:

x: number of documents,

y: number of employees in the company,

gray indicates the cost of maintaining revenue and expense ledger,

black indicates the cost of operating a full accounting,

A full plane indicated a fixed cost of a full-time employee.

The situation is similar in the case of cities with a population of 100,000 – 500,000.

Table 6

**Cost of services provided by an accounting office in a city with a population of 100,000 - 500,000**

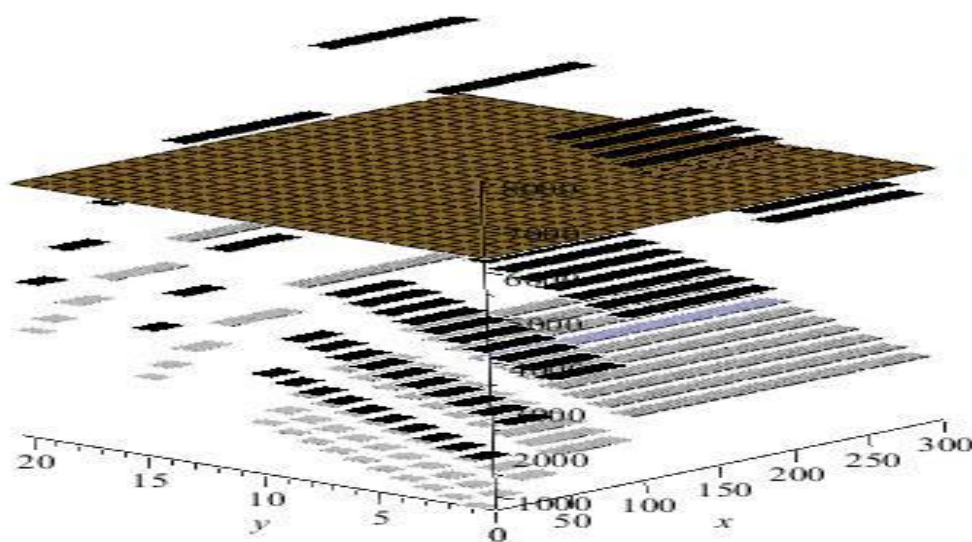
<b>documents/ Employees</b>	<b>Revenue and expense ledger</b>					<b>Full accounting</b>				
	up to 10	11 - 25	26 – 50	51- 100	100+	up to 20	21 – 50	51 – 100	101 – 200	200+
<b>1</b>	694.2 536	881.4 019	1149. 766	1546. 426	2063. 144	1772. 416	2405. 66	3206. 043	4253. 603	5701. 354
<b>2</b>	817.8 421	1004. 99	1273. 354	1670. 014	2186. 732	1896. 005	2529. 249	3329. 632	4377. 191	5824. 943
<b>3</b>	941.4 306	1128. 579	1396. 943	1793. 603	2310. 321	2019. 593	2652. 837	3453. 22	4500. 78	5948. 531
<b>4</b>	1065. 019	1252. 167	1520. 531	1917. 191	2433. 909	2143. 182	2776. 426	3576. 809	4624. 368	6072. 12
<b>5</b>	1188. 608	1375. 756	1644. 12	2040. 78	2557. 498	2266. 77	2900. 014	3700. 397	4747. 957	6195. 708
<b>6</b>	1312. 196	1499. 344	1767. 708	2164. 368	2681. 086	2390. 359	3023. 603	3823. 986	4871. 545	6319. 297
<b>7</b>	1435. 785	1622. 933	1891. 297	2287. 957	2804. 675	2513. 947	3147. 191	3947. 574	4995. 134	6442. 885
<b>8</b>	1559. 373	1746. 522	2014. 885	2411. 545	2928. 263	2637. 536	3270. 78	4071. 163	5118. 722	6566. 474
<b>9</b>	1682. 962	1870. 11	2138. 474	2535. 134	3051. 852	2761. 124	3394. 368	4194. 751	5242. 311	6690. 062
<b>10</b>	1806. 55	1993. 699	2262. 062	2658. 722	3175. 44	2884. 713	3517. 957	4318. 34	5365. 9	6813. 651
<b>15</b>	2424. 493	2611. 641	2880. 005	3276. 665	3793. 383	3502. 656	4135. 9	4936. 282	5983. 842	7431. 593
<b>20</b>	3042. 435	3229. 584	3497. 947	3894. 608	4411. 325	4120. 598	4753. 842	5554. 225	6601. 785	8049. 536

source: own

As in the previous case, hiring an accountant should be considered when the number of documents exceeds 200 and the workforce is 6 or more, while the entity maintains integrated accounts.

Figure 2

**Distribution of the cost of accounting services relative to the cost of employing accountants in medium-sized cities**



source: own

where:

x: number of documents,

y: number of employees in the company,

gray indicates the cost of maintaining revenue and expense ledger,

black indicates the cost of operating a full accounting,

A full plane indicated a fixed cost of a full-time employee.

It is no different in the cities with more than 500,000 inhabitants. Here, however, the number of employees is less relevant, and the key factors were the processed documents and the number of employees.



Table 7

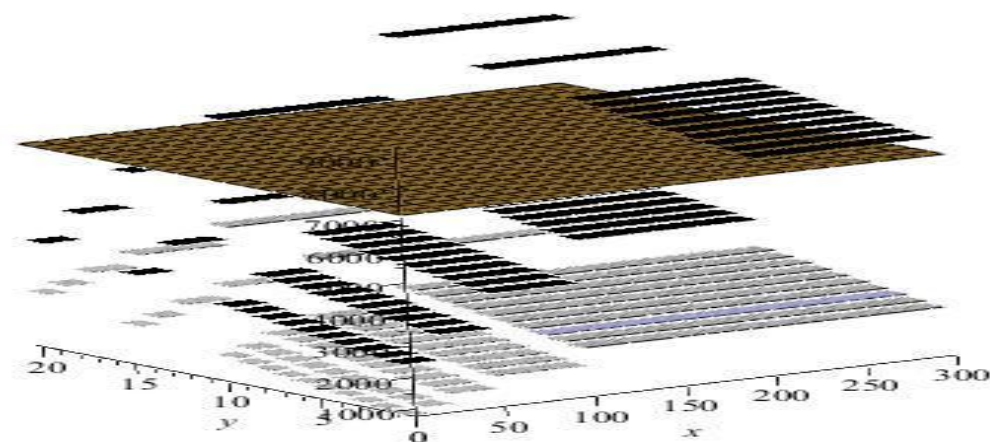
**Cost of services provided by an accounting office in a city with a population over 500,000**

	Revenue and expense ledger					Full accounting				
<b>documents/ Employees</b>	up to 10	11 – 25	26 – 50	51- 100	100+	up to 20	21 - 50	51 – 100	101 - 200	200+
<b>1</b>	765.6 603	966.9 33	1287. 086	1682. 569	2242. 837	2377. 019	3186. 818	4305	5682. 129	7636. 005
<b>2</b>	856.8 804	1058. 153	1378. 306	1773. 789	2334. 057	2468. 239	3278. 038	4396. 22	5773. 349	7727. 225
<b>3</b>	948.1 005	1149. 373	1469. 526	1865. 01	2425. 278	2559. 459	3369. 258	4487. 44	5864. 569	7818. 445
<b>4</b>	1039. 321	1240. 593	1560. 746	1956. 23	2516. 498	2650. 679	3460. 478	4578. 66	5955. 789	7909. 665
<b>5</b>	1130. 541	1331. 813	1651. 967	2047. 45	2607. 718	2741. 9	3551. 699	4669. 88	6047. 01	8000. 885
<b>6</b>	1221. 761	1423. 033	1743. 187	2138. 67	2698. 938	2833. 12	3642. 919	4761. 1	6138. 23	8092. 105
<b>7</b>	1312. 981	1514. 254	1834. 407	2229. 89	2790. 158	2924. 34	3734. 139	4852. 321	6229. 45	8183. 325
<b>8</b>	1404. 201	1605. 474	1925. 627	2321. 11	2881. 378	3015. 56	3825. 359	4943. 541	6320. 67	8274. 545
<b>9</b>	1495. 421	1696. 694	2016. 847	2412. 33	2972. 598	3106. 78	3916. 579	5034. 761	6411. 89	8365. 766
<b>10</b>	1586. 641	1787. 914	2108. 067	2503. 55	3063. 818	3198	4007. 799	5125. 981	6503. 11	8456. 986
<b>15</b>	2042. 742	2244. 014	2564. 167	2959. 651	3519. 919	3654. 1	4463. 9	5582. 081	6959. 211	8913. 086
<b>20</b>	2498. 842	2700. 115	3020. 268	3415. 751	3976. 019	4110. 201	4920	6038. 182	7415. 311	9369. 187

source: own

Figure 3

**Distribution of the cost of accounting services relative to the cost of employing accountants in large cities**



source: own

where:

x: number of documents,

y: number of employees in the company,

gray indicates the cost of maintaining revenue and expense ledger,

black indicates the cost of operating a full accounting,

A full plane indicated a fixed cost of a full-time employee.

It results from the research; the accounting offices' offer promotes the use of their services as an alternative to employment of full time accountants. It may be noted; however, that the price of services is higher in larger cities and in spite of the higher wage expectations of accountants, in most cases one should examine the possibility of employing a full time accountant.

## Conclusion

Expectations of market participants and the interactions that occur between them enforce such provisions, which will become extremely specialized. This makes it necessary for businesses to focus on their key operations in order to gain the trust of customers and at the same time it also affects the time and work efficiency regarding their own operations on less strategically important processes. This approach has become the basis for the popularity of outsourcing services in the modern economy.

The growth of importance of outsourcing is indicated in more and more areas of its interest. It is evaluated not only as a technical process of moving services outside together with its functions, disadvantages, or advantages, but also analyzed regarding its impact on the functioning of specific entities - and even countries. In addition, the importance of handling specific functions (accounting, IT, etc.) is subjected to assessment.

Despite some of the disadvantages of outsourcing as perceived by commissioning companies that cause their fear of separation; however, there is

the spreading belief in the appropriateness of its use. We are witnessing the transfer of activities outside the company, so that the service provider will perform them better and cheaper while reducing costs and often also increasing revenue. Achieving the goals should, however, be preceded by a preparatory phase within which the outsourcer will be able to compare the cost of acquisition of services with the expense of executing the tasks within the enterprise (such as the cost of outsourced accounting and the cost of home-based accounting).

It should also be noted that outsourcing is always a project consisting of two basic areas: The first is how the transfer in a specific area of operations to an external provider occurs, and the second relates to the long-term partnership. It is the correct course of the latter that guarantees that the expectations of both parties' expectations are met.

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# METHODS OF DETERMINING ENTERPRISE VALUE AND THEIR USE IN BUSINESS PRACTICE

*Zuzana NIŽNÍKOVÁ – Denisa BILOHUŠČINOVÁ*

## **Abstract**

Through analysis and evaluation of the results, we followed by the analysis of sensitivity. It consisted of the several proposals of some variants and finding the best decisions how to increase the economic value of the company. Sensitivity analysis was carried out at a substance and revenue method by the change in the individual methods.

## **Keywords:**

Enterprise value, assets and liabilities, factors, profit

## **Introduction**

A market value is a summary indicator of the company success. This indicator also testifies about the success of its financial policy. Each enterprise is unique and it is not easy to compare it with other companies in the same field of business as well.

The assessment of enterprise is a complex process affected by many factors. Items of the business property are formed the way to best and most effectively meet the production program and the achievement of corporate objectives. A synergistic effect causes the situation that the enterprise is usually greater than the sum of the individual parts of its property. While assessing the enterprise value is necessary to take into consideration a potential revenue in addition to the real value of the property, and at the same time a market position and prospects of the development for a longer time.

## **Enterprise value and the reasons of its assessment**

Enterprise Value is determined by the future revenue at all owners or investors in the company, taking into account the time value at a given time and place.

Levels of business value:

**Gross value** - is the value of the enterprise as a whole. The content is the market value for both owners and creditors. The solution is to value the assets.

**Net book value** - a value set by the owners of the company. In principle, determines the value of equity and net assets. (Mařík, 2003)

Division of methods:

- I. Equity method,
- II. Revenue recognition methods
- III. Combined methods,
- IV. Market method.

## Characteristics of X, j.s.c.

X, j.s.c. is an emerging company with more than 50 years of experience with the processing of raw materials. Company under that name was founded in 1998 and was transformed by XY, Ltd. and is registered in the Commercial Register of District Court in Presov. It employs about 126 employees and is one of the medium-sized enterprises.

A major scope of the company:

- mining activities on opening, preparation and extraction of exclusive deposit zeolites in Nižny Hrabovec extraction area,
- Production of non-metallic mineral products,
- Manufacture and sale of Feed additives E568 clinoptilolite of sedimentary origin,
- production of compound fertilizers.

## Application of the equity method on the company

If the values of balance sheet data were applied to calculate the equity method, we get:

$$HP2009 = 8\,669\,504,2 - 1\,368\,495,7 = 7\,301\,008,50,-\text{€}$$

Tab. 1

### Overview of the value of the company value during 2009-2011

Year	2009	2010	2011
Enterprise value	7 301	7 692	8 822
(€)	008,50	004,30	157,20

Source: own processing

State and development of enterprise value X, JSC. During the period 2009-2011 is described by the following chart.

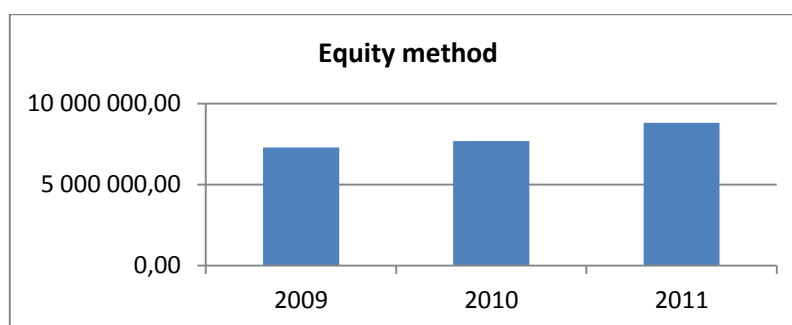


Fig. 1

### Enterprise value - Substance method

Source: Own processing

## Application of the revenue recognition method on the company

The market value of the company is determined by the revenue recognition method as 8360 724.24, - €. Compared to the substance method a computed value is approximately the same, so we concluded that a long-term financial plan of the company is realistic and can be achieved. Expecting growing development in the future, it is able to get earnings, but at the same time it is needed to take into account constantly changing market conditions, increased competition, and the development. Therefore, the enterprise should realize regularly controls and update its financial plan (expected revenue, profits, etc.).

In the chart below, we visualized the development of the market value of the enterprise X, j.s.c. during analyzed years by the revenue recognition method. We noted an increasing trend and minimal deviation values the same as at substance method. We therefore assume an increasing development in the future working on the assumption that a set plan is being met.

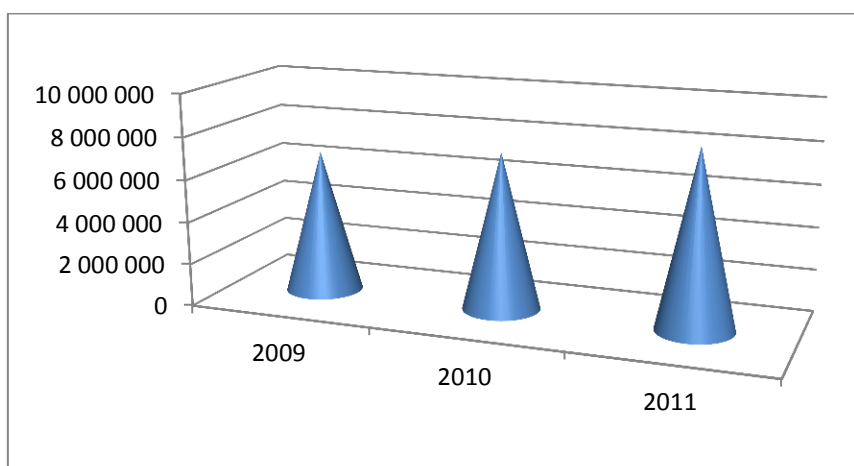


Fig. 2

### Development of the company's value - revenue method

Source: Own processing



## Application of combined methods on the company

Because of the popularity in the practice, we have chosen this method (average value) of the group of combined methods for determining the value of company X, JSC. Through most often utilizing combination of the substance method and revenue method, we calculated the value in two ways.

Determination of the unweighted average of the company:

$$HP_{2011} = 8\,412\,549,82,-\text{€}$$

Determination of the weighted average value of the company:

$$HP_{2011} = 8\,422\,914,94,-\text{€}$$

Tab. 2

### Results of the enterprise X value, j.s.c. for coming years - average value method

Enterprise value (€)	Year	
	2009	2010
Unweighted average	7 039 843,75	7 553 674,65
Weighted average	7 092 076,70	7 581 340,58

Source: own processing

An average market value of the company unweighted and weighted varies minimally. The difference in the calculation is that using the second method, that is a determining the enterprise of X, j.s.c. using a weighted average, we took into consideration the expert opinion of granting 40% of the weight of the revenue value, when the remaining 60% devolved on the substantial value. By the calculation some inaccuracies that occurred using previous methods should be partially offset.

## Application of the market method on the company

The company can not work without customers. The position on the market, including other things, determines the skill and knowledge based on the knowledge about customers and their behavior, market position and their purchasing power. Accordingly this, we have chosen this method from the group of market-based methods.

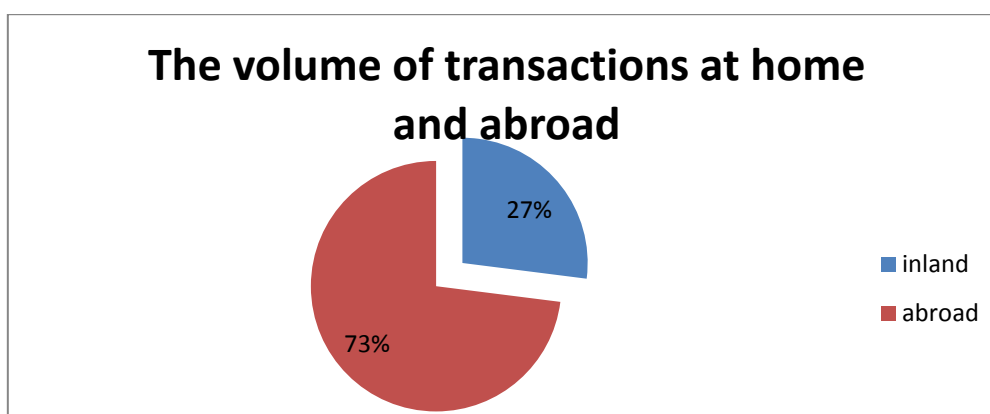


Fig. 3

**Volume of trades Zeocem a. s.**

Source: Own processing

Company X, j.s.c. exports the vast majority of its production abroad. Due to the trade secrets of X, j.s.c., we have named its customers according to the specific countries where the company exports its production.

Tab. 3

**The volume of transactions of the most important consumers of Zeocem, j.s.c.**

State / trading volume in €	The volume of transactions for the year					
	2009		2010		2011	
	€	%	€	%	€	%
INLAND	2 522 387	33,39	2 355 196	26,88	1 889 200	20,18
POLAND	1 668 139	22,11	3 164 742	36,12	3 383 843	36,15
NETHERLANDS	721 422	9,55	872 546	9,96	1 148 258	12,27
CZECH REP	752 936	9,97	732 370	8,36	906 593	9,68
GERMANY	687 632	9,12	551 416	6,29	602 547	6,44
ITALY	209 213	2,77	259 454	2,96	255 684	2,73
<b>OVERALL</b>	6 561 729	86,91	7 935 724	90,57	8 186 125	87,45
<b>Total volume</b>	7 554 209	100	8 763 064	100	9 361 351	100

Source: own processing

The table shows that X, j.s.c. delivers its production to its biggest customers in approximately the same percentage without major fluctuations for each year of the period. On average, 26.82% of trading volume in the total volume of transactions is carried out in the country. The most important customer for the company is a customer Poland that is involved in the volume of trades on average 31.46%. The table shows that X, j.s.c. consolidates its business with customers Poland, what is confirmed by the steady percentage increase in trading volume during each year.

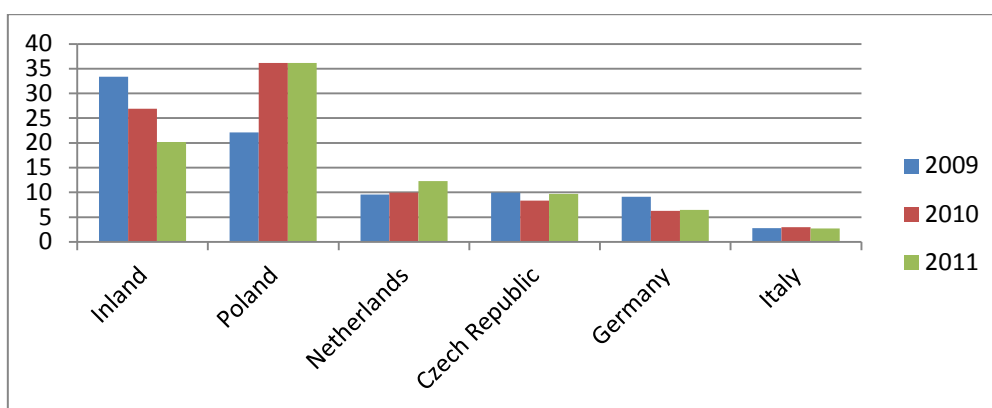


Fig. 4

#### The percentage of trading volume from 2009 to 2011

Source: Own processing

Among other major customers we can include the Netherlands, Czech Republic, Germany and Italy. The remaining approximately 10% of trading volume is attributable to other foreign countries such as Belgium, Korea, Croatia, Switzerland, etc.

Tab. 4

#### Overview of products and services

Own products and services (%)	Year		
	2009	2010	2011
Cement processing	3,87	1,32	0,78
Klinomix	34,97	42,26	38,19
Zeolit	33,08	30,51	38,35
transportation	14,68	16,34	19,4
Granulest KL	10,09	6,46	0
other	3,31	3,11	3,27

Source: Own processing

In the table 9, we processed an expected volume of transactions in the future. We were based on data from the table 7 and internal resources of the company X, j.s.c.

Tab. 5

#### Predicted business volumes in €

Year	2012	2013	2014
	9 829 419 €	10 615 772 €	11 571 192 €

Source: Own processing

The prerequisite for the period 2012 to 2014 was determined based on the growing trend of the company businesses X, j.s.c. between 2009 and 2011. The company X, j.s.c. was compared with competitors on the domestic market, which B, j.s.c. in eastern Slovakia.

Based on available information in the table below, we processed the business volumes of B, j.s.c. transactions for a period of three years, starting in 2008. The company operates on the domestic and foreign markets, with a focus on the foreign customers, as well as in company X, j.s.c.

Tab. 6

**The volume of transactions of the company B, j.s.c.**

**The volume of transactions in a year (€)**

<b>2008</b>	<b>2009</b>	<b>2010</b>
290 147	318 738	660 836

Source: Own processing

Comparing B with a competitor we reviewed the X, j.s.c. is more prosperous company. An important factor is that it operates on the market much longer, so by this it developed the image, long-term business relationships with its major customers and so on. Another difference lies in the size of firms and hence the volume of the business. X, j.s.c. is a highly prosperous company and based on available information and results we evaluated the expected business volumes were realistic respecting given market conditions and the company can expect a positive development for the future. On the domestic market, X, j.s.c. represents a strong competitor just for its long tradition and size. A strong customer base (especially abroad) and quality of products are two key factors that build X, j.s.c. as a leading position on the domestic market.

## Discussion

The determination of the enterprise value was carried out by four chosen methods from all groups of methods for determining the enterprise value. In the following table we summarized the results of the work, so the enterprise value of X, j.s.c. calculated by selected selected during the period of three years starting from 2009.

Tab. 7

**Total value of the enterprise value respecting selected methods**

<b>Method/year in €</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
<b>Substance method</b>	7 301 008	7 692 004	8 822 157
<b>Revenue method</b>	6 778 679	7 415 345	8 362 285
<b>Average value</b>	7 039 843	7 553 674	8 412 549

Source: Own processing

The table shows an increasing trend in the enterprise value of company X, j.s.c. during each year. This positive development is characterized by:

- good position and competitiveness of X, j.s.c. and on domestic and foreign markets,
- low costs,

- long-term effect of X, j.s.c. on the market, which has undergone various changes,
- quality and a high level of the offered production
- wide product range,
- regular customers, who make up about 90% of the volume of sales,
- continuous improvement and innovation of production technology.

Using the method for comparing the customers we evaluated that the company X, j.s.c. has a strong base of customers mainly in foreign countries who are involved in the volume of trades on average 73%, domestic customers on average 27%. Comparing with the competitor B, j.s.c. the company in terms of domestic market is very prosperous, because of its long existence, the size of the company and rumour.

### **Analysis of the sensitiveness on the substance method**

The analysis of the sensitiveness was carried out by the changing variable debts and liabilities maturity by the change from 60 days to:

A) 90 days

B) 30 days.

Tab. 8

#### **Comparison of alternatives by the analysis of sensitiveness of the substance method**

##### **Year 2011**

Actual value 8 822 157,-€

Variant A 8 822 476,-€

Variant B 8 821 836,-€

Source: Own processing

It proves that the change of variable maturity of assets and liabilities has a minimal effect on the value of the company. The option A seems to be the best option at maturity of assets and liabilities 90 days because of the reason that present liabilities of the company exceed trade receivables. In practice is valid that the shorter period of the maturity of debts is, the better for company.

### **The influence of the sensitivity analysis method on the revenue method**

In this method, the decisive factor was the impact of changes in risk premium, whose real weight in each time of the phase we changed from 5%, 6% and 7% to:

A) the first time phase - 10%

in the second phase- 11%

in the third phase- 12%

B) in the first time phase - 1%

in the second phase - 2%

in the third phase - 3%

The calculated value of the business variant X, j.s.c. by the impact of the risk premium and the real value of the company has been processed in the following table.

Tab. 9

**Variants scenarios of the revenue method**

**Year 2011**

The actual value	8 362 285,-€
Variant A	6 320 884,-€
Variant B	11 124 290,-€

Source: Own processing

Data from Table 9 are visualized in the chart below, which provides an overview of trends.

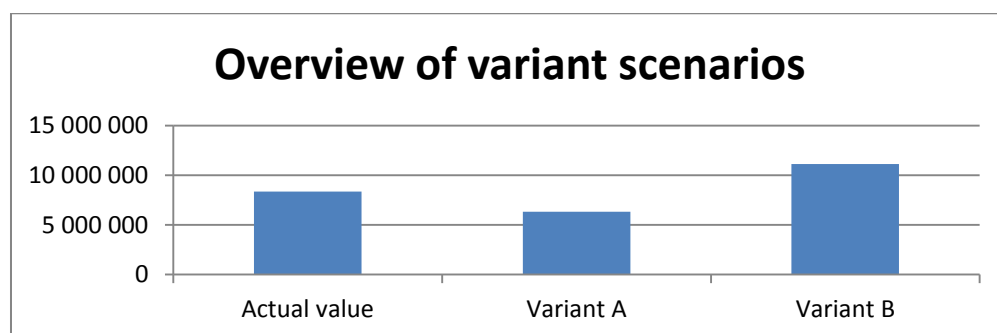


Fig. 5

**Overview of variants of revenue method**

Source: Own processing

The graph shows that the best variant scenario for the company would be option B, which represents the higher value of the company 2,762,005 - €, so 33% compared to the actual value calculated for the year 2011. Conversely A variant would be a lower value of the company by 24%. The impact of the factor a risk premium is important. Respecting a low risk premium, that is represented by the variant B, the company can increase its market value, if there is a minimal risk and conditions on the market are not changed.

**Proposals to increase the company's value**

Company X, j.s.c. is suggested to plan its profit at a lower risk premium - to maximize profit, which would increase the market value of the company based on a growing trend in the economic result each year, the volume of transactions and the total value of the company, which was evaluated in the watched period. In the critical period, the company did not use any bank loans or assistance, resulting in a high proportion of own resources on total resources, which reflects the stability and independence of X, j.s.c. It means that the company can draw

foreign capital through loans and overdrafts, which can be used to upgrade and reconstruction of the technology, which will increase the market value of the company. We recommend to undergo the audit of property to this company, to watch the maturity of liability and assets more carefully, dividing its customers according to the history of their payments, by what they would avoid financial problems.

Based on the comparative analysis of comparing customers we suggest to increase business volumes and by that the anticipated sales orientated on emerging markets, to develop business relations with foreign partners with a small percentage of the volume of their transactions and also to increase the volume of production on the domestic market.

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# THE NUMBER OF SQUARE ROOTS IN THE SPECIAL LOCAL RING

## POČET ODMOCNÍN V ŠPECIÁLNO M OKR UHU

*Rastislav JURGA*

### Abstact

This article is focused on the investigation of the number of square roots in the special local ring.

### Keywords:

local ring, special local ring, anulator of the element, number of square roots

### Abstrakt

Článok je zameraný na štúdium počtu odmocnín v špeciálnom lokálnom okruhu.

### Kľúčové slová:

lokálny okruh, špeciálny lokálny okruh, anulátor, počet odmocnín

## Introduction

Introduce the basic concepts. Let  $R$  be a finite commutative ring with the unit 1. Let a characteristic of the ring  $R$  is odd.

**Definition 1.** The ring  $R$  is called local if it has only unique maximal ideal. Denote this maximal ideal be the symbol  $I$ .

We will call the elements of the set  $R - I = R^*$  regular elements of the ring  $R$ . Next, we will call the elements of the ideal  $I$  singular elements of the ring  $R$ .

**Definition 2.** The local ring  $R$  is called a special local ring if its maximal ideal is principal. Let  $g$  be a generator of the ideal  $I$ , thus  $I = (g)$ .

Assume that there is  $k \in N$  such that

$$g^k = 0 \tag{1}$$

**Definition 3.** An index of nilpotency of the ring  $R$  is the smallest integer  $\nu \in N$  such that

$$g^\nu = 0 \tag{2}$$



Denote a homomorphism from the ring  $R$  on a factor ring  $R/I$  by the symbol  $\varphi$ , thus  $\varphi: R \rightarrow R/I$ . The homomorphism  $\varphi$  is called canonical. It is obvious that  $R/I$  is a field, denote the factor ring  $R/I$  by the symbol  $\bar{R}$ .

**Definition 4.** An anulator of the element  $a \in R$  is the set

$$Ana = \{x, xa = 0\} \quad (3)$$

**Lemma 1.** It holds for every  $\mu \in N$

$$|Ang^\mu| = |Ang|^\mu \quad (4)$$

Proof. [3]

**Lemma 2.**  $|Ang| = |\bar{R}|$  (5)

Proof. [3]

**Theorem 1.** Every element of the ring  $R$  can be expressed in the form

$$a = a_1 g^n, \quad n \in N, \quad a_1 \in R^* \quad (6)$$

where  $n$  is determined uniquely.

Proof. [4]

## 1 MAIN RESULT

**Theorem 1.1.** Let  $d = d_1 g^\alpha \in R$ . Then

1. there is in  $R$  a square root from  $d$  if and only if  $\bar{d}_1$  is a square in  $\bar{R}$  and

$$\alpha = 2\delta.$$

2. if there are full filled the conditions of the first statement then  $d$  has

a)  $2|\bar{R}|^\delta$  square roots if  $d_1 \neq 0$  (7)

b)  $|\bar{R}|^{\left[\frac{\nu}{2}\right]}$  square roots if  $d_1 = d = 0$  (8)

Proof. 1. Let  $a^2 = (a_1 g^\xi)^2 = d = d_1 g^\alpha$  then  $a_1^2 = d_1$ ,  $2\xi = \alpha$  and  $\bar{a}_1^2 = \bar{d}_1 \in \bar{R}$  what was necessary to prove.

2. Conversely: Let  $d \neq 0 \neq d_1 = a_1^2, d = d_1 g^{2\delta}$ .

Then  $a = a_1 g^\delta$  is one square root from  $d$ . We search the another square roots in the form

$$y = a - x$$

Thus

$$y^2 = a^2 - 2ax + x^2 = a^2$$

it means that

$$x^2 = 2ax \quad (9)$$

Put  $x = x_1 g^\xi, a = a_1 g^\delta$ . We get by a substitution in (9)

$$x_1^2 g^{2\xi} = 2a_1 x_1 g^{\delta+\xi}$$

and thus

$$\frac{x_1}{2a_1} g^{2\xi} = g^{\delta+\xi}$$

We distinguish two cases

a/ let  $g^{\delta+\xi} \neq 0$ . Then

$$x_1 = 2a_1, 2\xi = \delta + \xi, \xi = \delta$$

We get from the relation (9)

$$x(x-2a) = 0$$

e. g.

$$(x-2a)x_1g^\delta = 0$$

what it means that

$$x-2a \in \text{Ang}^\delta$$

Conversely: If  $c = x-2a \in \text{Ang}^\delta$  then  $(x-2a)x_1g^\delta = 0$ . Because  $c = c_1g^\chi$  then

$$\chi \geq \nu - \delta \geq \frac{\nu-1}{2} > \delta. \text{ Then}$$

$$x = 2a + c(2a_1 + c_1g^{\chi-\delta})g^\delta$$

Then the number of elements  $\bar{a}$  full filled the relation is equal

$$|\text{Ang}^\delta| = |\text{Ang}|^\delta = |\bar{R}|^\delta$$

b/ let now  $g^{\delta+\xi} = 0$  and we search a solution  $x$  full filled the relation (9). For this  $x$  it holds obviously  $\delta + \xi \geq \nu$  and  $2\xi \geq \nu$ . Because  $\delta \leq \left\lfloor \frac{\nu}{2} \right\rfloor$  then it holds

$$\xi \geq \nu - \delta$$

Conversely: for each  $\xi \geq \nu - \delta$  and  $x_1 \in R^*$  is  $y = a - x_1g^\xi$  the square root from  $d$ . It means that those square roots there is

$$\sum_{\xi=\nu-\delta}^{\nu-1} |R^*g^\xi| = \sum_{\xi=\nu-\delta}^{\nu-1} \frac{|R^*|}{|\bar{R}|^\xi}$$

We get by a reordering

$$R^* \sum_{\xi=\nu-\delta}^{\nu-1} \frac{1}{|\bar{R}|^\xi} = \frac{|R^*|}{|\bar{R}|^{\nu-1}} \frac{|\bar{R}|^\delta - 1}{|\bar{R}| - 1} = |\bar{R}|^\delta - 1$$

Then the number of all square roots is

$$|\bar{R}|^\delta + |\bar{R}|^\delta - 1 + 1 = 2|\bar{R}|^\delta$$

3. Let now  $d = 0$ ,  $x = x_1g^\xi$  then  $x^2 = x_1^2g^{2\xi} = 0$ . It follows immediately from this that  $2\xi \geq \nu$  and to each those  $\xi$  there is  $|R^*g^\xi|$  solutions. Analogically as in b/ we get the statement.

## CONCLUSION

The reached results enables the next study of the special local ring.

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# ECONOMIC ASPECTS OF NUCLEAR WASTE STORAGE

## EKONOMICKÉ ASPEKTY USKLADNENIA JADROVÉHO ODPADU

*Sergej F. STRAJŇÁK - Tomáš ŠCHÜTZ - Lenka PČOLINSKÁ*

### Abstract

The main theme of the article is to present new possibilities for storage of nuclear waste (spent nuclear fuel) using bentonite with excellent adsorption properties. These chemical properties of bentonite, as well as the relatively low cost of this natural material present to 21 century one of the options for permanent storage of this type of hazardous waste. The article is divided into three main parts, namely a general section on nuclear energy (energy of the nucleus, nuclear reactions), nuclear waste (management of nuclear waste) and the last part of the research, which presents research results of adsorption properties of chemically activated bentonite.

**Key words:** Bentonite, spent nuclear fuel, nuclear reaction, atoms, management of storage

### Abstrakt

Hlavnou témou článku je prezentovať nové možnosti uskladnenia jadrového odpadu (použitého jadrového paliva) pomocou bentonitu s výbornými adsorpčnými vlastnosťami. Práve chemické vlastnosti bentonitu, ako aj relatívne nízke náklady tohto prírodného materiálu predstavujú pre 21. storočie jednu z možností pre trvalé uskladnenie takéhoto typu nebezpečného odpadu. Článok je rozdelený na 3 hlavné časti, a to všeobecnú časť o jadrovej energetike (energii jadra, jadrovej reakcii), jadrového odpadu (manažmentu s jadrovým odpadom) a na poslednú výskumnú časť, ktorá prezentuje výsledky výskumu adsorpčných vlastností chemicky aktivovaného bentonitu.

**Kľúčové slová:** Bentonit, jadrový odpad, jadrová reakcia, atóm, manažment uskladniene

## 1 NUCLEAR ENERGY

### 1.1 Nuclear fission process

A common example of induced fission consists of bombarding  $^{235}\text{U}$  nuclei with thermal neutrons<sup>10</sup> (slow neutrons). A neutron is captured by the U-235 nucleus forming a very unstable  $^{236}\text{U}$  nucleus that instantly breaks up into two smaller fragments, each about half the original mass: Barium-142 ( $^{142}\text{Ba}$ ) nucleus and Krypton-91 ( $^{91}\text{Kr}$ ) nucleus with the release of three neutrons ( $n$ ) and a large amount of energy.  $^{235}\text{U} + n \rightarrow [^{236}\text{U}] \rightarrow ^{142}\text{Ba} + ^{91}\text{Kr} + 3n$ . The three neutrons start three processes just like the initial one, resulting in nine neutrons plus energy. This proceeds on and on with threefold magnification each of released neutrons and energy at each step. It is a nuclear chain reaction (Win, 2006).

## 1.2 Nuclear fusion process

There is an intense interest in fusion processes as they promise high energy yields with an abundant fuel source (hydrogen), producing only small amounts of radioactive waste – a relatively “clean” reaction resulting in manageable waste disposal. A nuclear fusion reactor design are still in the experimental stage and differs greatly from that of fission reactors - the major problem is containment of very hot plasma fuel (millions of degrees) - magnetic fields have been used in various ways to hold the plasma in a “magnetic bottle” (Win, 2006).

## 1.3 Sizes of Atoms and Nuclei and their energy

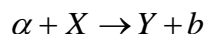
The diameters of atoms and molecules are of the order of  $10^{-10} - 10^{-9}$  m. On the other hand, the diameters of nuclei are small, of the order of  $10^{-15} - 10^{-14}$  m. Size of molecules is often measured in Å (angstrom,  $1 \text{ Å} = 10^{-10}$  m) and nm ( $1 \text{ nm} = 10^{-9}$  m). On the other hand, the size of nuclei is often measured in fm (femtometer,  $1 \text{ fm} = 10^{-15}$  m). That is, the diameters of atoms and molecules are approximately 0.1-1 nm and diameters of nuclei are approximately 1-10 fm. Because of the uncertainty principle, a much higher energy is associated with a nucleus than with an atom or a molecule, as it is much smaller. Chemical reactions are measured in the unit of eV (where 1 eV is the energy acquired when a particle with one elementary electric charge is accelerated by a potential difference of 1 V in vacuum). In contrast, the unit of MeV ( $1 \text{ MeV} = 10^6 \text{ eV}$ ) is usually used for nuclear reactions. An approximate, but rather more concrete explanation is given by the following. The  $n$ -th energy eigenvalue for a particle with mass  $m$  trapped inside a potential well of size  $L$  is given by the following equation:

$$E_n = N_n \frac{1}{2m} \left( \frac{\pi \hbar}{L} \right)^2$$

Here  $N_n$  is a constant determined by the quantum number  $n$  and  $\hbar = 6.582 \times 10^{-16} \text{ eVsec}$  is the value obtained by dividing Planck's constant by  $2\pi$ . For an atom of size 0.1-1 nm, the energy is 38-0.38 eV. In the case of a proton, the energy is 200-2 MeV for a nucleus of size 1-10 fm (Sekimoto, 2007).

## 1.4 Nuclear reactions in general

A nuclear reaction is generally described as follows:



Here,  $\alpha$  is an incident particle,  $X$  is a target nucleus,  $Y$  is a residual nucleus, and  $b$  is an emitted particle. Reactions where no  $\alpha$  is involved are called decays. Before and after the nuclear reactions, the total energy and momentum are conserved for the system. From these conservation laws, restrictions apply to particle energy and direction of motion in the reaction. In the laboratory coordinate system, the target nucleus  $X$  is considered to be at rest. Thus, the following equation holds based on the energy conservation law:

$$(M_a + M_x)c^2 + E_a = (M_b + M_y)c^2 + E_b + E_y$$

Here, relativity theory is ignored, and  $M_a$ ,  $M_x$  represent the respective masses and  $E_a$ ,  $E_b$ , etc. represent the respective kinetic energies in the laboratory coordinate system. We call the increase in kinetic energy due to the reaction the  $Q$ -value or the reaction energy:

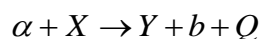
$$Q = E_b + E_y - E_a$$

It is clear that this also corresponds to the decrease in mass due to the reaction:

$$Q = [(M_a + M_x) - (M_b + M_y)]c^2$$

From this equation,  $Q$ -value can be obtained from only the masses of the particles involved in the reaction. Thus,  $Q$ -value does not depend on the energy of incident particle.

The reaction equation is sometimes written by adding  $Q$ -value to Equation.



The  $Q$ -value can take either a positive or negative value. When it is positive, the reaction is called an exoergic reaction. When it is negative, the reaction is called an endoergic reaction. An endoergic reaction cannot take place unless the energy of the incident particle  $\alpha$  surpasses a certain minimum value. This minimum value is called the threshold energy and it can be obtained by the following equation:

$$E_{ath} = -Q \frac{M_a + M_x}{M_x}$$

When the residual nucleus Y is left in an excited state, the mass of Y is larger than the mass of the ground state  $M_y$ . If we denote this mass by  $M_y'$ , the Q-value for this reaction is expressed by the following equation, which is different from that for the ground state, as  $Q' < Q$ .

$$Q' = [(M_a + M_x) - (M_b + M_y')]c^2$$

In this case, the energy of the emitted particle  $E_b$  is clearly smaller. The residual nucleus Y in the excited state will eventually decay by some decay process (Sekimoto, 2007).

## 2 NUCLEAR WASTE (SPENT NUCLEAR FUEL)

Worldwide, the nuclear power industry generates approximately 10,500 metric tons of heavy metal (“MTHM”) spent fuel each year (IAEA, 2007). Spent nuclear fuel shows almost a complete spectrum of radioactivity. Some of elements in SNF will remain radioactive for hours to a few years whereas others for thousands to millions of years. Rate of change of any of radioactive nuclei in SNF can be represented by the following equation (A. Rana, 2012).

$$\frac{dN_i}{dt} = \left. \frac{dN_i}{dt} \right|_{form} - \left. \frac{dN_i}{dt} \right|_{decay}$$

whereas concentration or number of a specific specie of nuclei at any time are given by the following equation,

$$N_i(t) = N_i(t_0) + \int_{t_0}^t \left. \frac{dN_i}{dt} \right|_{form} - \int_{t_0}^t \left. \frac{dN_i}{dt} \right|_{decay}$$

where  $t_0$  is the starting time whereas  $t$  is any time afterwards. It is clear from above equations that composition of SNF will continue changing, but in a quite deterministic way assuming initial composition of SNF is known. It is an important point to be considered while selecting containment materials and disposal site (A Rana, 2012).

Table 1  
Classification and characterization of radioactive waste

<i>Classification of radioactive waste</i>	<i>Characterization</i>
<i>I. High activity, long life</i>	<i>High intensity of <math>\beta</math>- or <math>\gamma</math>-radiation Large <math>\alpha</math>-activity High radiotoxicity Large making of heat</i>
<i>II. Medium activity long life</i>	<i>Medium intensity of <math>\beta</math>- or <math>\gamma</math>-radiation Large <math>\alpha</math>-activity medium radiotoxicity medium making of heat</i>
<i>III. Low activity, long life</i>	<i>low intensity of <math>\beta</math>- or <math>\gamma</math>-radiation Large <math>\alpha</math>-activity Low or medium radiotoxicity negligible making of heat</i>
<i>IV. Medium activity, short life</i>	<i>Medium intensity of <math>\beta</math>- or <math>\gamma</math>-radiation negligible <math>\alpha</math>-activity medium radiotoxicity medium making of heat</i>
<i>V. Low activity, short life</i>	<i>low intensity of <math>\beta</math>- or <math>\gamma</math>-radiation negligible <math>\alpha</math>-activity Low radiotoxicity negligible making of heat</i>

Source: (Kováčová & Lesný & Šturdík, 2012)

### 3 NUCLEAR WASTE MANAGEMENT

#### 3.1 Bentonite

Bentonite is a natural material, available in Slovak Republic. In general, it is a rock with dominant presence of clay minerals from the smectite group, mainly montmorillonite. The properties of bentonite result from the crystal structure of this group. The particles of montmorillonite have negative charges on their faces due to isomorphic substitutions in structure. In the tetrahedral sites  $\text{Si}^{4+}$  can be replaced by  $\text{Al}^{3+}$  and in the octahedral sites  $\text{Mg}^{2+}$  can replace  $\text{Al}^{3+}$  (M'bodj et al., 2004). This negative charge is compensated by the presence of the cations in the interlayer space, which are not fixed and have the character of so called "exchangeable cations" (i.e.  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Li}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ) which can be exchanged for other foreign cations from environment. Bentonite is thanks to these structural properties of montmorillonite known for its high swelling ability and low hydraulic conductivity, good sorption properties in comparison with other natural materials (Galamboš et al., 2010). It is possible to use bentonite as a



sorbent of dangerous elements either without any treatment or in its modified form. The chemical modification of bentonite is feasible due to the presence of water molecules at the surface and exchangeable cations in the interlayer space of montmorillonite structure. The basic chemical treatment includes preparation of the monoionic form of bentonite which can be received by the ionic exchange of cations of the alkali metals or alkaline earth metals. Example of such modification is saturation with monovalent cations of sodium. Natrification salt  $\text{Na}_2\text{CO}_3$  is used almost exclusively thanks to its financial accessibility (Galamboš et al., 2010).

Bentonite is normally fine-grain material with the content of the particles that by their size belong to natural micro and nanomaterials (Kraus, 2011). From the point of view of manipulation and application it is therefore more convenient to incorporate bentonite into stabile matrix. Example of such stabile systems is the composite known under the term of geosyntetic clay liners (GCL) that combines bentonite with geosynthetic materials. These seal liners are widely used as hydraulic barriers at the construction of landfills or in the other areas (Andrejkovičová et al., 2008). The alternative application of natural or chemically activated bentonite as adsorption barrier for nuclear waste storage was studied.

### 3.2 Materials and Methods

For the experiments, natural bentonite from the deposit of Stara Kremnička – Jelšový Potok with the chemical formula  $[\text{Si}_{7.95}\text{Al}_{0.05}][\text{Al}_{3.03}\text{Fe}_{0.22}\text{Mg}_{0.75}]\text{O}_{20}(\text{OH})_4(\text{Ca}_{0.42}\text{Mg}_{0.04}\text{Na}_{0.01}\text{K}_{0.01})$  was used (Mockovčiaková et al., 2010). The natrified bentonite (Na - bent.) was prepared using activating agent  $\text{Na}_2\text{CO}_3$  and distilled water to which the natural bentonite was added. The stabilization took 24 hours at ambient temperature. The final product was dried and mashed manually. The inevitable parameter to evaluate the sorption properties of the natural and activated bentonites is the CEC (Cation Exchange Capacity). It is defined as the quantity of cations reversible adsorbed by clay particles, expressed in milliequivalents per 100g of dry clays. The methylene blue stain test makes it possible to quantify the cation exchange capacity of the samples by measuring the quantity of methylene blue cations necessary to cover the total (external and internal) surface of the particles. Laboratory tests were performed as combination of two applicable standards: AFNOR (French Association for Standardization) and ASTM (American Society for Testing and Materials) (Chiappone et al., 2004).

In order to compare the sorption properties of the studied materials, sorption of cadmium cations from synthetic solution  $\text{Cd}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  was performed at the ambient temperature. The initial concentration of cadmium was in the range of 10 to 700mg/L. The concentration of adsorbent was 1g/L. The sorption was done in polyethylene tubes on the rotary stirrer, pH of the solution was set to 5.

Stirring time was 24 hours. The concentration of the metals was determined by the method of atomic adsorption spectroscopy.

### 3.3 Results and Discussion

The values of CEC were calculated according to the formula (Lorandi et al., 2010):

$$CEC = \frac{V \frac{C}{M_r}}{m} 100,$$

where  $V$  is the total volume of methylene blue solution titrated (ml),  $C$  is the concentration of methylene blue solution (g/L),  $M_r$  is the molecular mass of methylene blue and  $m$  is the sample mass (g). The data of CEC for all measured samples are shown in Table 2.

Table 2  
Cation exchange capacity (CEC) of studied samples

Samples	CEC
natural bentonite	84.4
Na – bent.	114.1

The Figure 1 shows the isotherms of cadmium sorption at the natural bentonite and the Na –bent., while the sorption data were fitted with the help of linear shape of Langmuir isotherm (Figure 2) and calculated from the formula (Schütz et al., 2013):

$$\frac{C_e}{q_e} = \frac{1}{Q_m b} + \frac{C_e}{Q_m},$$

where  $C_e$  is the equilibrium concentration of the metal ions in the solution,  $q_e$  is the amount of the adsorbed metal related to the weight unit of the adsorbent (mg/g),  $Q_m$  represents the maximal adsorption capacity (mg/g) and  $b$  is the sorption equilibrium constant (L/mg). The values of Langmuir parameters for the sorption of  $\text{Cd}^{2+}$  cations are given in Table 3.

Table 3  
Langmuir parameters for sorption of Cd<sup>2+</sup> cations

Sample	$Q_m$ [mg/g]	$b$ [L/mg]	$R^2$
natural	63.29	0.032	0.9964
Na – bent.	72.99	0.019	0.9964

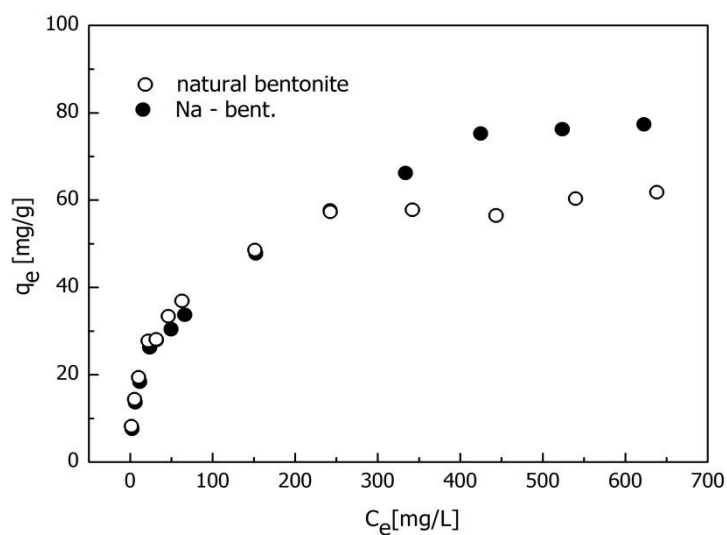


Figure 1  
Sorption of Cd<sup>2+</sup> on natural and activated bentonite

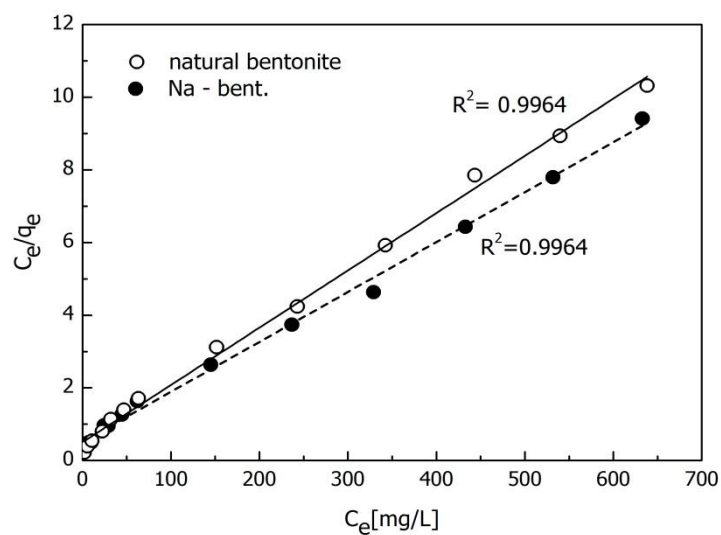


Figure 2  
Linear form of the Langmuir isotherms of Cd<sup>2+</sup> sorption

## CONCLUSION

Activation of bentonite with  $\text{Na}_2\text{CO}_3$  represents its cheap chemical modification. Activated bentonite reached higher values of cation exchange capacity (evaluated by adsorption of methylene blue cations) and higher maximum adsorption capacity (determined by  $\text{Cd}^{2+}$  sorption) than natural bentonite. It offers a seal material with very good sorption efficiency for dangerous elements which can be considered suitable for nuclear waste storage.

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# WHAT COULD POSSIBLY GOES WRONG: CASE STUDY OF FAILED CONTINUOUS IMPROVEMENT EFFORTS IN CONSTRUCTION COMPANY

*Michal TKÁČ – Róbert VERNER*

## **Abstract**

This paper covers three important issues of continuous improvement; definition, tools, implementation. The article firstly define continuous improvement than it is explains what it is and what it is not. The basic definition about corrective action and innovation are also stated here. Then the tool of continuous improvement are presented and analysed. Last part of the literature reviews ends with the critique of continuous improvement. Research is based on case study which demonstrates the usage of mentioned tools in practise. It explains how lack of knowledge, inappropriate use of quality management can ruin any continuous improvement effort.

## **Keywords:**

Continuous improvement. Construction company.

## **Introduction**

To exact determine the term quality is very hard even though it is known and very often used term. The main problem is that quality is in term of product and services very subjective attribute. For that reason should be better to focused on the factors, conditions and parameters which were already set and by whose the require characteristics of products, process and services will be achieved. So quality improvement can be very basically understand as an convergence or achievement of set status, values or events of the subjective attributes which can be done only by meeting exact defined terms. (Nenadal:1998)

So defined quality improvement allow using wide range of various qualitative and quantitative tools, methods, techniques and systems not only effectively but also exactly.

According to Tkac (2001) classic approach to quality improvement consists of five steps:

1. Explanation of reasons and setting the aims.
2. Evaluation of present situations
3. Analyse of possibilities
4. Plan and realization of actions
5. Results interpretation

The most important value of the continual improvement is that this particular approach does not end in the fifth step but it automatic continues in fist step of another improvement. (Tkac:2001) It has to be underline that the best way how to achieve the continuous improvement is through its tools. Every tool has a specialized framework. This framework is made by conditions. Some of the

conditions are absolute other are recommending. By meeting the recommending one the effectiveness of the process increases. The second one on the other hand prevents the failures of the process. Therefore is essential to know chosen tool as good as possible, which can be done only through the education and experience.

Historically, there is a lot of successful method of quality improvement. This paper will focused on those, witch are based upon the continuous improvement.

The paper consists of three parts; it begins with descriptions of continuous improvement as a technique of quality improvement and explains the importance of it. After that short critique of the continuous improvement is presented. The research part begins with the case study of construction company which used all the tools mentioned above to improve its processes. It has to be also highlighted that from wide portfolio of the construction company's processes where most of the processes have effectively implemented PDCA cycle, it was chosen one which in the begging look effective but than failed.

## Literature review

The term continuous improvement is often badly interpreted as an innovation or corrective action. To understand the distinctiveness is important to define it. Quality Requirement System 9000 defines continuous improvement as:

*“For those product characteristics and process parameters that can be evaluated using variable data (data where measurements are used for analysis), continuous improvement means optimizing the characteristics and parameters at a target value and reducing variation around the value. For those product characteristics and process parameters that can only be evaluated using attribute data (data that can be counted for recording and analysis—attributes data are usually gathered in the form of nonconforming units or of nonconformities), continuous improvement is not possible until characteristics are conforming.” (QS 9000: 1998 cited by Peterson and Reid:1999)*

These definitions outline the main difference between continual improvement and correction actions. The continual improvement is possible only in case that the products achieve the customer's requirements or in case that the process is stable. Stabilization of process can not be considers as its “improvement”. Stabilization is the more about repairing process than improve it. (Peterson and Reid:1999) Referring to ISO 8402:1994 “the corrective action” can be interpreted as steps which remove sources and “prevent recurrence” of already appeared “nonconformity” (when the baseline expectation are not achieve), disfuncionality or further unwanted moments. (ISO8402:1994 cited by Peterson and Reid:1999) What is important in the effort to clearly set the borders between continuous improvement and corrective actions is the phrase ‘already appeared’ which determine the application of corrective actions.



Basically the continuous improvement start when the process is stable so when the corrective actions finish. (Peterson and Reid:1999) It has to be also highlighted that continual improvement instead of solving existed problems is based upon the searching for possibilities to improve company, which makes the continuous improvement more “preventive” than “corrective” approach. (BSI: 2002)

Continual improvement isn’t also innovation. Innovation can be defined “something newly introduced: a new method, custom, or device or perhaps, a change in the way of doing things.” (Peterson and Reid:1999) It can not be argue that continual improvement sometimes by modifying processes brings some degree of innovation as well as every usually brings an improvement. The main issues which distinguishing these two terms are dimension of change and time factor. Innovation is usually characterized by tremendous changes which happen once for a while. On the other hand continual improvement is dynamic approach which brings smaller incremental changes and is based on never-ending and uninterrupted improvement. (Sykora:2007) The table below highlights the differences between the terms mentioned above.

Table 1

**Differencies between innovation, continuous improvement, corrective actions**

Improvement activities	Examples/Intent/Characteristics
Innovation	<ul style="list-style-type: none"> <li>• Capital expenditure</li> <li>• R&amp;D</li> <li>• Relies on specialists</li> <li>• Sporadic breakthroughs</li> <li>• Revolutionary</li> <li>• Project-based</li> </ul>
Continuous improvement	<ul style="list-style-type: none"> <li>• Product (part) characteristics, especially special characteristics (within specifications)</li> <li>• Variable data are mandatory</li> <li>• Small increments</li> <li>• All employees are involved</li> <li>• Evolutionary</li> <li>• May be project-based</li> <li>• Daily improvements</li> </ul>
Corrective actions	<ul style="list-style-type: none"> <li>• Problem resolution (4.1.4.1.1)</li> <li>• OK Product characteristics are out of specifications</li> <li>• Assigned case by case as required</li> <li>• Improvements that lead to product and process conformance</li> <li>• Attribute data</li> </ul>

Source: Peterson and Reid:1999

Other problem is that terms continual improvement and continuous improvement are frequently used “interchangeably.” That is the reason why is sometimes hard to understand what type of improvement do the authors have in mind. Continual improvement includes according to W.E. Deming all the processes inclusive “discontinuous” improvement, which is another big branch of improvement.(ASQ:2007) Continuous improvement is a subset of continual improvement emphasis on “linear” and “incremental improvement” in the companies processes. Some authors link this term to “statistical process control,” (ASQ:2007)

Present continuous improvement come to America and West Europe as was mentioned above from Japan in the sixties. These countries started to be interested in this approach mainly because of west observers of east practices and techniques and because of authors as Masaaki Imai. (Cole: 1999 p.36) The core of whole continual improvement approach is in processes. Through the process changes the improvement is created. The process improvement in twenty-first century is characterized by creating a lot of various approaches and methodologies such as Kaizen, Just-in-Time, Six sigma and Reengineering etc. All of these innovative methods were creating in the industry, because academics start to be interested in after the success in companies. (Spear and Bowen: 1999) According to Weick and Westley (1994) the advantages of continuous improvement are:

- Continuous improvement involve big group of people on company improvement, on the other hand innovation involve only specific specialists.
- Big volume of little changes can be created simultaneously or one after another, what finally can cause important changes in term of positive outcome.
- Continuous improvement determines continuous learning which is gradually implemented into the daily routine of the employees. This form of learning is considered to be most effective form of use continuous improvement in employees practise.

### **PDCA cycle**

During the continuous improvement development, one of the firsts and most frequently used approach was “four-step model” PDCA which was used by Deming and Shewhart. (ASQ:2007) It is “process chart” illustrating “learning and process improvement”. The creation of the cycle was based upon the Shewhart’s effort to understand “process of learning”. Shewhart (1986) assumed that three important components of knowledge are existed:

- a) Data from experience, where the process of cognize begins.
- b) Prediction in term of data, which can be expected when the assumed conditions happened

c) “Degree of trust” in this prediction

Because induction or prediction based upon the experimental data can not be 100% sure, knowledge based upon the original data can has only a certain degree of “rationality”. Basically, Shewhart was confident that knowledge has a character of probability. Those three aspects of learning were by Shewhart and Deming adapted to new model of products and process improvement. As can be seen in figure 1: PDCA cycle consist of four steps, plan do check and action, which will be now described.( Shewhart:1986)

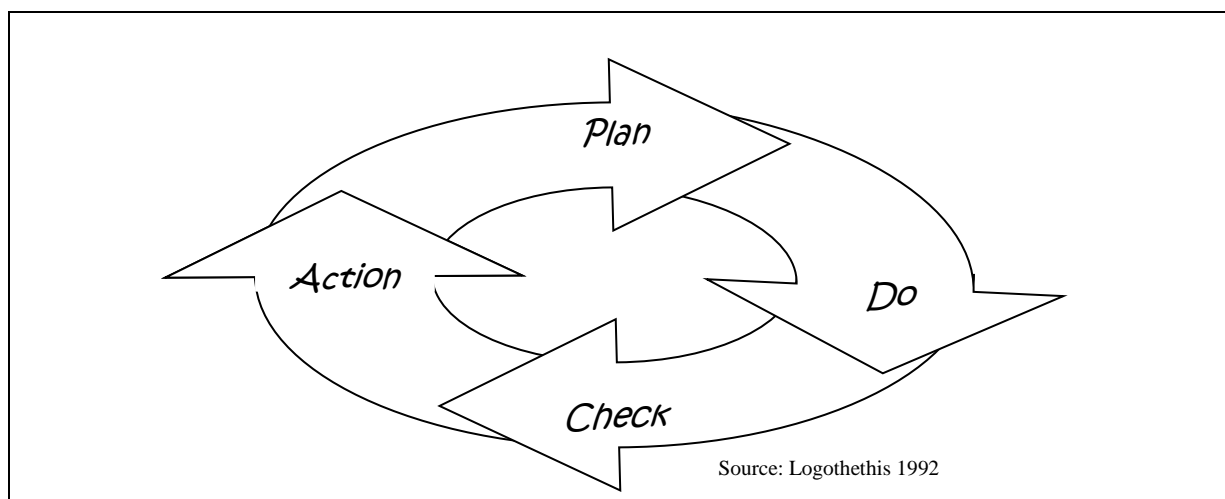


Figure 1  
PDCA cycle

### Other tools of continual improvement

Recent management use lot of various tools, which could improve the quality of their products and services. According to Oakland (2003) the classic tools of continuous improvement are: Cause and effect analysis, check sheets/tally charts, Pareto analysis, stratification, histograms, scatter diagram, control chart, brainstorming, flowcharts.

Ishikawa states that 95% of all problems can be solved by these tools. (Ishikawa cited by Nenedal:1998) Key of success of these tools is they ability to find the problem, use the tools which was for the problem appropriate and solves the problem sooner than other methods do. (Tkac: 2000) Most frequent are in practise used Pareto analysis and Ishikawa’s cause and effect diagram. On the other those tools are often used without the evaluation if they are appropriate to solve the problem or not, so they application are often uselessly. To prevent this event is very important to define which tools are useful for which problem and then apply them. (Tkac:2000) In order to preserve length of the paper, characterisation of mentioned tools were omitted. Description of such tools can be found for example at Tkac (2000), Gitlow et al., (1989) Hand and Plowman (1992), Ryan (1989) and Oakland (1999)

## **Critique of continuous improvement**

The tools mentioned above were very often used in practise to improve the quality of products through “the process control” and “process improvement”.(Tkac: 2000) On the other hand is important to realize the problematic issues which led to their reduction in practise. In companies with implemented continuous improvement systems often happened that the role of the company’s leadership was only based upon the project approbation there was no further effort. This attitude is totally against the definition of continual improvement, which clearly underlines the participation of all the employees; leadership include. However the full participation approach is common and fully accepted in Japan, the other counties like Europe and USA with differences in business culture have problems to implement it. That is the reason why the continuous improvement approach is not as successful in these countries as it is in Japan. (Cole:1999) Other issue was creating the quality department what means that the responsibility for quality was transferred from employees to people which control it. This approach creates problems in implementing quality as a whole company and also problems with allocating the resources. The utilization of continuous improvement tools was problematic in Europe and USA because they use them only for solving the “soft” problems apart of Japan where these tools was used to solve the “hard” problems. The Japan was also focused on “customer’s satisfaction” but in Europe and USA “the customer’s satisfaction” was achieved by employee’s threat. All these differences led to the companies’ unpopularity of this type quality control system. (Cole:1999)

Other angle of view can be seen through the Juran’s cost of quality theory, which noticed that not every improvement will be economically lucrative. That the reason why can be said that the present company can not make all its decision based upon the quality of production. There is also important underline that the utilization of continuous improvement tools was inept because their benefit for company was impossible to quantify. On the other hand the cost of improvement was exactly quantified and top management knows how many they spent for quality improvement. The benefit which these cost brings was not always recognized or add to continuous improvement’s account. Therefore the continuous improvement projects were not chosen based upon the economical criteria because it was hard to quantify them. The decisions were made mainly in term of faith of success or in term of how good the resources will be used which could be exactly quantified. (Logothetis 1994)

The problem of improvement through the seven tools is in their short profile specialization which is focused mainly on production and technical part of quality. The company’s activities and the profits are not defined only in production part of the company but also in its supports activities. There is a lack of interest in activities as logistics, marketing and so on. Other problem is that mostly the improvement is done only on departmental basses without interdepartmental improvement. To assure continuous improvement the

company has to be seen as a one consistent process which has to be improved. (Tkac: 2001)

## **Methodology**

Methodology has an aim to demonstrate the application of the PDCA cycle and other additional tools of continuous improvement in practise. To achieve these aims the research strategy called case study was chosen.

The construction company has a problem with idle costs, which are common cost in companies. The continuous improvement tools are used to reduce these costs. On the other hand the case study approach is a useful to underlines the relationship between the tools; the way how the one approach depend to another. The way how these tools were used in the company and the order of using it is typical in business and recommended by authors like Ishikawa, Oakland or Tkac, therefore it should be apply elsewhere.

The case study below is based upon the real facts and real problems of existing company. It is single case embedded case study which means that it is based upon single case and has lot of units to analyze. The units of analyzing are continual improvement tools and the case study will be describing when they were used, how they were used and analyze how they fit into the company's purposes.

The presented case study will also have a chronological structure, which means that the study will be presented events in chronological order to underline the succession of particular stages. (Yin:1994 p.139) Because most of this information were used in practise and have important role in company decision making, it can be consider that they have a high degree of validity. Some information was provided by employees, its validity can be considered as low. In order to preserve anonymity of the source, some names and numbers were changed.

## **Research**

Whole process improvement process started 4<sup>th</sup> of April 2005 when the annual report of construction company for a year 2004 was published. The report describes that the activities which dealt with building, repairing, reconstruction and inspection of chimneys, produce in 2004 a loss 2 863 000 SKK (95 034€). So that board of directors of construction company gives the task to financial department to find out what are the reasons of the loss. After the deeper analyses it was found out that bigger responsibility for the loss have inappropriate costs. Based upon the analysis it was found that even though the year 2004 present 5% decrease in term of contracts the costs of these activities presented in the same years increase more than 14%. The analyses made by financial department found out that the bigger impact on the cost have idle time. Idle time can be defined as "a time when operators or machines, whilst capable

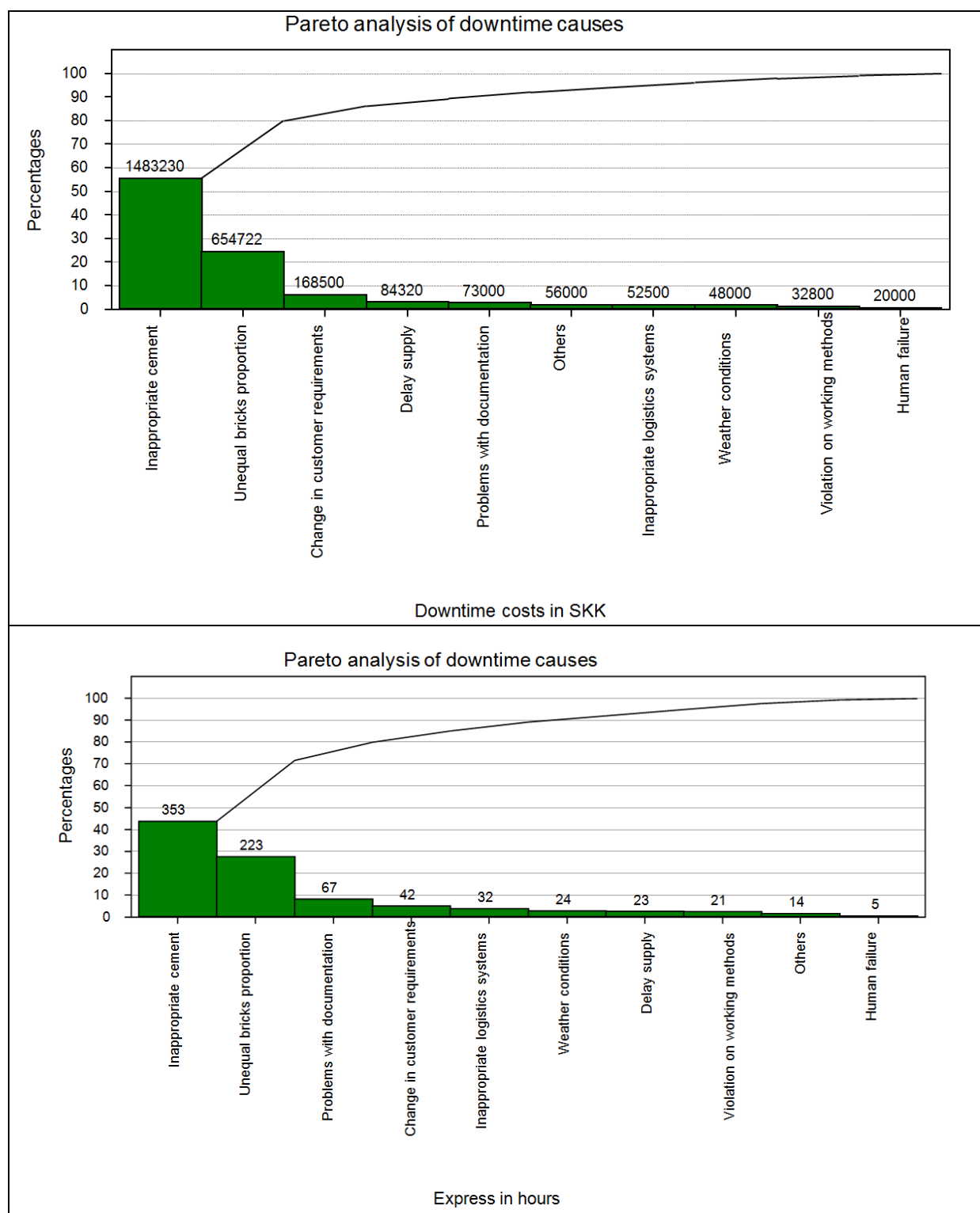
of operation, are not producing because of some hold up not associated with the capacity to operate the machine.”(indiainfoline : 2007) As the financial report states the idle time cost company money twice; firstly when they occur by paying for using the sources even they are not uses for example paying stuff or paying for hired machinery. Secondly the impact of idle time is presented by fines and penalties for not finishing the tasks on time. In term of activities mentioned above these cost create 30% of all cost. Therefore the financial department in the end of the report stresses the importance of decreasing the idle time costs and recommended to solve this problem as soon as possible.

## **Plan phase**

The board of directors in the meeting in June 2005 based upon the financial department report qualified the problem of high downtime cost as a priority problem and delegates the quality improvement team to find the way how to reduce it. The quality improvement team which consists of three administrators and two technologists decided to organize the brainstorming session with the aim to detect all the possible causes which can make idle time. In session which takes place on 9 of December were three engineers, two construction managers, two blue collar workers, one quality consultant and one building inspectors. The people were selected either because of their competency in term of building, repairing, reconstruction and inspection of chimneys or because they worked previously on constructions where the idle time occur very often. The brainstorming session takes two hours and has three phases. Firstly all the members of the sessions were welcomed. Then the quality improvement team tried to explain to all the members the reasons for this session, its importance and also it try to introduce the basic principles of brainstorming. This part of the meeting takes 20 minutes and after then the session problem was introduced. The main question of the session was; what are causes of downtime occurrence? After the introduction the moderator of the session explains the terms idle time and open the short ten minutes discussions with the aim to make sure that everybody understand the topic. Then come the ‘brainstorming’ part where the members named all possible causes of idle time. After that the quality improvement team sorted all the causes into the categories Ishikawa’s cause and effect diagram were created. Based on diagram the quality improvement team started to analyze particular cause factors with the aim to find out how big impact does they have on the process of creating idle time. This was a complicated task because a lot of various cause factors determines a lot of various analyses that can be used to describe their impacts.

For the purpose of the case study it is better to focus on the cause analysis which was done through the Pareto diagram. Before the Pareto diagram was constructed other continual improvement tool was used to gather a data for it. The tool was check sheet and it was especially designed for this purpose. It has two parts; on first part the hours of down time were recorded, on the second part

the volume of down time were recorded. The data for Pareto analysis were gathered in 6 various place for a six months. Based upon the data, three different Pareto diagram was created. The translated version of diagrams can be seen in figure 2.



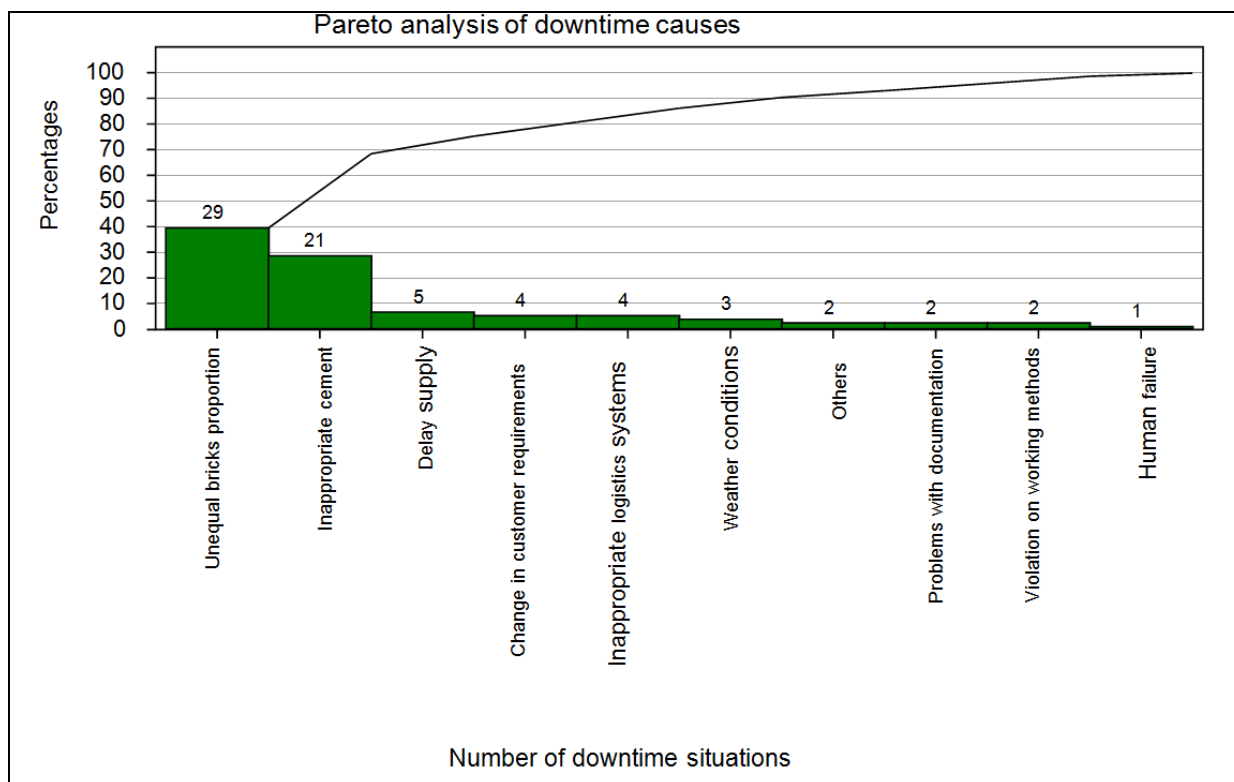


Figure 2  
Pareto analysis of down time situations

The Pareto diagrams were demonstrated that the biggest impacts on the downtime costs have inappropriate cement and unequal bricks proportion. Those issues were identified as problems caused by poor quality supplies. Therefore the quality improvement team decides to increase its quality. The team declares the current system of supplier's assessment as dysfunctional and as a main cause of poor quality supplies. The system was determined by three criteria; transportation distance, price, and timeliness. Every criterion was evaluated from 1 to 10. The supplier which has more then 20 points was approved. Flowchart of old system is presented in Figure 3. The quality improvement team makes a commitment to reduce the costs caused by suppliers by 30%. The team split this cost into: costs caused by poor quality supply, cost of supply, transportation cost, costs caused by delay supply. These indexes were chosen as measurement system for improvement. To achieve this aim team decided to improve the old process by sending questioners, adding a pro-approval phase and also by improving the evaluation criteria. Flowchart is also available at Figure 3. The designed process had these steps:

1. Searching for all suppliers distant in 500 km radius from the construction.
2. Sending the questionnaires all possible suppliers. The questionnaire was design based upon the evaluation criteria which was designed based upon the competitions' questionnaires.
3. Evaluating the answer from suppliers. If at least half of all the points was achieved the supplier is consider as approved. Translated questionnaire is available on Appendix E



4. On-site audit. The construction company creates a team of specialist with the aim to evaluate the supplier by specially designed criteria. Appendix F
5. Categorization of supplier based upon the on-site audit evaluation.
  - Category A (80% -100%) approved supplier- contract is signed for short time max. for 1 year.
  - Category B (65%-80%) conditionally approved- contract signed only when is lack of category A suppliers. Contract signed max. for 6 months.

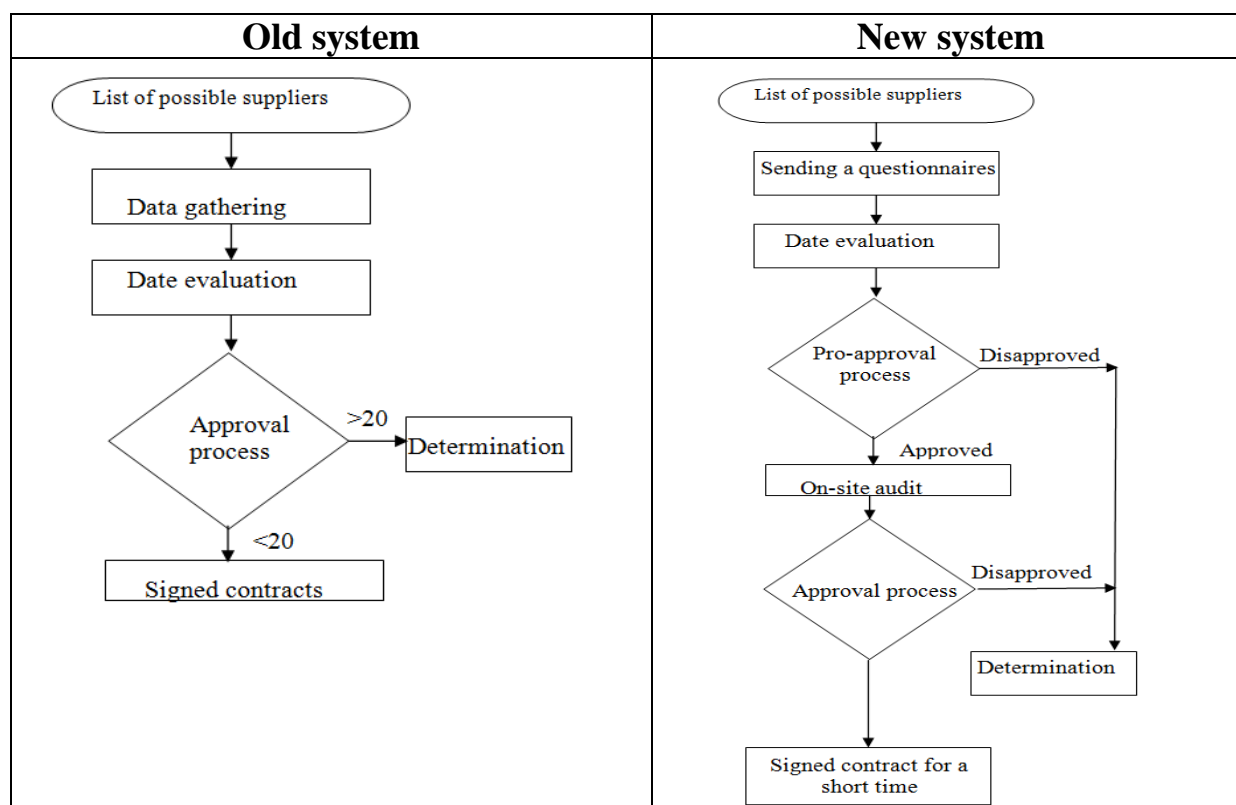


Figure 3  
Old and new system of supplier's assessment

### Do phase

The Do phase started in February 2006 by choosing places where the contracts with suppliers end in Jun and therefore are suitable for testing a new process. . It was allocated 8 buildings. Two of them were from the Kosice from the same town as construction company, other 4 were located in small village near the Kosice. Other one was from small town far from Kosice called Snina and the last one was in Starobesenovo in Ukraine. After that, all founded suppliers in radius 500 km from the constructions' places were contacted and the questionnaires were sent them. Also the team of auditors was formed, and during the March and April the on-site audits of chosen suppliers were made. In the begging of the May the year contracts which starts in June were signed.

## **Check phase**

Base upon the particular document, the check phase was based upon comparing the results which six units located in area near the Kosice provide in the years 2005 and 2006. Three months; June, July and were compared in term of indexes mentioned above. The costs caused by customers decrease by 8,3 % in average. The cost caused by poor quality supplies decrease by 15,7% in average. On the other hand the transportation cost increase by 43%. Based upon these increase the quality improvement team recommended to add value to those evaluations criteria, which deal with transportation.

## **Action phase**

In action phase was whole process improvement find as successful. The process of implementation results into the practise started by creating documentation. Then after the commentary process, which gives the employees place to presents their concern about this improvement, were the documentation implemented into organizational structure as a standard-practise procedure and it was distributed to all units of construction company The training which educate in utilization of this procedure was also practised.

## **Six months after...**

Despite all the actions the costs caused by downtime were not radically reduced. On the other hand some units had some problems with firms which had implemented ISO standards and also were close to their workplace but the construction company needs material with better characteristics then ISO standard has. The construction company also started to move its production more to Ukraine and Hungary. The new process which was hardly acceptable in Slovakian conditions, totally failed in Ukraine and Hungary. The following analysis will demonstrate the root causes why the continuous improvement process does not reach expected standards.

## **Analysis of continual improvement process:**

The construction company is a company with long tradition in processes improvement, but the core of their improvement is characterized by technologic process improvement and also by development new methods for the applications of refractory materials. The point of this is that even thought is construction company characterized by many specialist in term of continuous improvement, the examined problem was solved by technical staff which were in some improvement teams but were not educated enough for solving this problem. That why the attitude to problem was sometimes in formal basis. Some operative actions were made only pro-forma without a specific purpose. The complex approach to solved problem was missing. The preparatory stage can by characterized by these mistakes:

- Although the company has a lot of experienced professionals the quality improvement team consists of not experienced administrators and technologist.
- In this stage of improvement, education of the team members was neglected.
- The rules and principles of team work such as communication and organization was broken.
- From the beginning, the team was making decisions which were not supported by any statistical or others quality methods.

The brainstorming was used correctly as well as coversheet or cause and effect diagram. Then the Pareto analysis was also used right and identified that the root causes of the downtime are caused mainly because of poor quality of supplies.

### **Plan phase critique:**

The quality improvement team underestimated the plan stage. They do not consider possible diversity of examined problem. They focused only on the last year results, which were the impulse for improvement. They also do not consider the future expansion of the company to the new sectors and new countries. All these issues finally causes the contraction of examined framework, where the team only consider those problems and difficulties which happened recently.

### **Recommendation for plan phase:**

The construction company ltd should be more focused on education in term of improvement. Existed education which is mainly focused on construction managers and people working on construction should be improved also to administrators and technologist. Although the improvement is in administrative area not in construction one it is appropriate for plan stage, to create the team from experienced technological improvers till the administrative improvers do not get enough knowledge and experiences. It is also very important to have a complex thinking, to think outside the box, when the PDCA cycle is used. The plan phase framework should not only represent the past events but also illustrated expected problems and complication which could occur in term of future development of the company.

### **Do phase critique**

The decision to asses the suppliers through the questionnaires and evaluation criteria can be consider as a correct. On the other hand the process how these issues were created, evaluated and interpreted seems to be inappropriate. The questionnaire created in plan stage should be based upon the causes which where identified in brainstorming session and presented in cause and effect diagram. There should be direct linkages between the causes and questions or evaluation criteria. Other mistake is that no pilot study was done.

The aim of this pilot study is to find out if the questions in the questionnaire are appropriate and understandable. The weight system what is system which for every answer provide exact value should be verified also. Based upon this system the importance of suppliers is checked.

### **Recommendations for do phase:**

It will be useful to use the stratification in this particular stage. This can be done by splitting all constructions units into the groups based upon accessibility of those suppliers which satisfied construction company mostly. This stratification should present the big differences in term of quality supplies between the construction units. The difference should be seen between construction units in the big cities and in the far villages. In the big cities designed questionnaire had relatively good outcome, because of selecting only the highest quality suppliers from environment where is competition high. The constructions units in the far village, which are not supplied by the prestigious suppliers because it is not so profitable for suppliers, those units on the other hand do not benefit from questionnaire at all.

### **Control phase critique**

In control phase the prepared questionnaires were used in the conditions for which the questionnaires were not suited. They were used in conditions which were not considered in plan stage. For example in Ukraine as well as in Snina the inappropriate measurement systems were used. Therefore the questionnaire based upon the standards set by construction company was useless. It often happened that even though the company based upon its measures proclaimed that the standards were achieved, in reality it was not truth. The big mistake of this stage was that the quality improvement team does not recognize these different conditions and implemented the questionnaires without any modification or changes.

Till the result from those units were interpreted and the problems were discovered, the mentioned questionnaire was already distributed and used as standard procedures, so the other construction managers have to used it to assess theirs suppliers.

The reason why all this happened was that quality improvement team does not handle the pressure from its superiors and want to fix the downtime cost as soon as possible. Team working under the pressure releases this directive, by which the action phase begun. The decision about the success of the improvement process was based upon the evaluation of six construction units. The main problem was that all of them were allocated near the second biggest town in Slovakia characterized as high competitive environment. All the units were supplied by prestigious suppliers therefore in the process of evaluation no problems were found. The quality improvement team released the directive even though the first problems in Snina had occurred. The lack understanding of

PDCA cycle methodology can be proved by proposal which was made by one member of the quality improvement team, when he was in one unit in Ukraine, where the first problems occurs. He proposes to refuse the application of new directive for this particular unit and rely on the experience of other companies in this area which cooperate with construction company.

### **Recommendation for control phase:**

As a corrective action it will be good to create an evaluation procedure for suppliers which usually supplies common building sites but do not have quality certificate or enough experience in quality control. Although they are appropriate for other companies they could be inappropriate for the high specialized firm such as construction company from case study. On the other hand it will be also useful for units which used the material with highly specified characteristics to evaluate the future supplier by using the reference; the latest experience of other company with the same supplier. To assure the objectivity of evaluation it will be good for company not to rely on test result provided by suppliers but execute its own tests by using its own procedures. Later research shows that through the precisely set aims and education in their's achievement, the suppliers without quality certificate could be a cheaper source of quality supplies.

### **Action phase critique:**

Firstly it has to be criticised that in this particular process the action phase should not start. The action phase could start only in case that all results from all eight construction units were evaluated. Although the commentary process was done it was done in wrong time. It was done before the training so the employees do not really know what this method is about and therefore they do not know what to comment. Because of lack of comments the methods was implemented and very often formally used. There were some exceptions when the supplier does not meet the expected standards set by questionnaire but on the other hand has perfect price or it was only one who was accessible in that particular time, so the contract was sign with him. The irony is that as a reason for breaking the procedure, the downtime reduction was stated.

### **Recommendation for Action phase:**

In term of future actions, firstly, the new PDCA cycle based upon the same aims has to be made. It has to correct all faults and mistakes presented in the analysis above. Some members of quality improvement team declares that the current procedure needs only some modification in term of adding new measurement methods for suppliers which are in suspicions of not achieving expected standards. Because of planed expansion to country as Russia and

Belorussia it should be much better for the company to repeat all cycle again with considering these new events.

## Conclusion

The purpose of this paper was describing continual improvement effort which failed. This aim was achieved by case study of Slovakian construction company. It was created mainly based upon the secondary data which were gathered from construction company. The case study was presented step by step and chronologically. The used tools and techniques tried to be explain as in depth as it based upon the secondary data, goes. Here has to be stressed that the case study part of project has only explanatory role, it should only shows what happened in construction company. On the other hand the last part of paper has totally different role. It is evaluating the process improvement presented above critiques it and providing some recommendation for it. As was mentioned above this particular case study was chosen because the process acts like it was improved and then failed. The analysis part went through the whole process and finds the main reasons for its failing. It has to be said that, although the process of continuous improvement in construction company was based upon the principles of PDCA and also used the additional continuous improvement tools such as Brainstorming, cause and effect diagram and Pareto analysis, the results of improvement should be consider as insufficient. The analysis part discovered the root causes of it: Firstly the quality improvement team wasn't created properly; was uneducated and inexperienced, the process was not plan for condition where was applied and what was most important, the check phase was not finished when the action phase starts. It can be argued that mentioned procedure caused some reduction in downtime but this happened only in big industrial complex where the prestigious suppliers were around. In this particular situation the mentioned procedure bring substantial improvement. The reason why all improvement is consider as insufficient is, that those construction unit represent only small number of all planned constructions.

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# **SOCIO - ECONOMIC DEVELOPMENT OF THE CITY OF LUBLIN IN THE YEARS 1995-2010**

*Paweł MARZEC - Grzegorz KRAWCZYK*

## **Abstract**

Local development is a process of changes undergoing in a particular system, including needs and goals which are adequate for this system as well as its aims, preferences and the hierarchy of values that make up the economy of the local system. The most important context for the concept of "local development" is to be defined as socio-economic development. In this paper the authors use taxonomic analysis to examine the level of socio - economic development of Lublin in the years 1995-2010 . The analysis of 42 features describing this development shows that the economy of Lublin developed during this period. Analyzing the components of this development it was found that the progress takes place mainly in the economic and technical fields. Regressive development can be observed in the social sphere. It is mainly caused by the demographic situation of the city. Another problem identified for the city is also job market. It should be taken into consideration that the final result of the taxonomic analysis is determined by the selection of indicators. The choice of indicators is always a subjective decision and is dependent on the knowledge and experience of the researchers.

## **Key words:**

local development, development management, taxonomic analysis, socio-economic development

## **Introduction**

In the case of managing local development planning is the basis for action. The decisive factor is access to information and its processing into decisions. The local system lacks such a precise effectiveness measure as profit which can be found in the company. A reliable measure of local efficiency can be the effects of local economy in terms of economic - social - technical categories. So the most important context of the term of local development should be socio-economic development. The purpose of this article is to analyze the changes in the level of socio-economic development of the city of Lublin from 1995 to 2010. The analysis of its components should identify problem areas of the development of the city, which is to give guidance to further effective management of its development.

## **The Method of Analysis**

The structure of the research process of the level of development of socio-economic development of Lublin is shown in Picture 1. The task of measuring the potential of the city was divided into three stages<sup>12</sup>:

1. quantification of the most important results obtained by the local economy separately in each of these three areas of the test period;

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<sup>12</sup> W. Kosiedowski, *Teoretyczne problemy rozwoju regionalnego*, [in:] W. Kosiedowski (ed.), *Zarządzanie rozwojem regionalnym i lokalnym*, Towarzystwo Naukowe Organizacji i Kierownictwa, Toruń 2001., p. 41.

2. definition of synthetic indicators of the results achieved in each area (subcomponents and then components) in the studied years;
3. aggregation of all the indicators and relationships into one measure indicating the level of socio-economic development in the studied years.

In the first stage economic, social and technical effects of the city were described using indicators. All indicators used correspond to the formal requirements of quantitative analysis. Their diagnostics was examined and transformed into indicators of intensity<sup>13</sup>.

For the set of 15 elements of the studied traits in subsequent years and  $n$  features of development the following two-dimensional data matrix can be written for each subcomponent<sup>14</sup>.

$$X_c = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m1} & \dots & x_{nn} \end{bmatrix} \quad [1]$$

where:  $X_c$  – the matrix of diagnostic features for subcomponents in the studied ranges,  $x_{ik}$  – matrix elements and  $X_c$  refers to the amount of studied characteristics for the  $i$ -th ( $i = 1, 2, \dots, m$ ) object (the city in the studied year) and the  $k$ -th ( $k = 1, 2, \dots, n$ ) development characteristic.

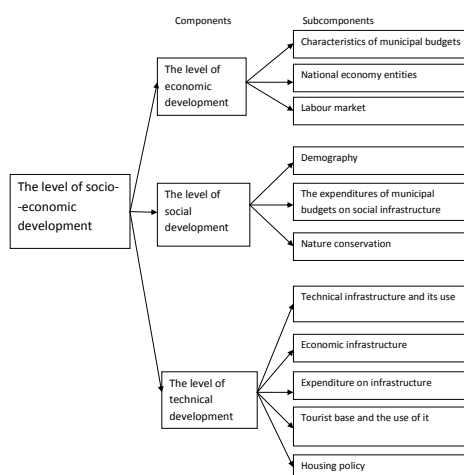


Figure 1

### The structure of analysis of the concept of the socio-economic development

Source: Own research.

The variables which were used from set  $X_c$  should indicate a significant level of differentiation of social, economic and technical potential. Volatility rates are used in order to determine how "strongly" selected measures define differentiation of the development of the city. Volatility is calculated as the quotient of the standard deviation of the value in a set of analytical variables and

<sup>13</sup> Ibid., p. 41.

<sup>14</sup> H. Ponikowski, *Wstępna zbiorcza analiza taksonomiczna poziomu rozwoju powiatu lubartowskiego i jego gmin*, [in:] Raport końcowy usługi „Planowanie Rozwoju Lokalnego” Moduł C „Studium Lokalnego Potencjału Gospodarczego Powiatu Lubartowskiego”, Centrum Kształcenia Menedżerów Przemysłowych, Lublin, 2004, p. 11.

their arithmetic mean. The higher the volatility rate is, the more objective the selection of the corresponding variable characterizing the potential proves to be<sup>15</sup>.

Coefficient of variation is thus calculated as<sup>16</sup>:

$$V_k = \frac{S_k}{\bar{x}_k} 100 \quad [2]$$

where:  $\bar{x}_k$  -arithmetic mean of the  $k$ -th feature of development calculated according to the formula:

$$\bar{x}_k = \frac{1}{n} \sum_{i=1}^n x_{ik} \quad [3]$$

whereas  $S_{x_k}$  is standard deviation calculated as

$$S_k = \sqrt{\frac{1}{n} \sum_{i=1}^n (x_{ik} - \bar{x}_k)^2} \quad [4]$$

The next step is unification of the nature of variables through transforming measures of the destimulants type into measures which are stimulant, accordingly<sup>17</sup>:

for stimulant:

$$x'_{jk} = x_{jk} \quad [5]$$

for destimulant:

$$x'_{jk} = \max_j x_{jk} - x_{jk} \quad [6]$$

as a result we obtain adjusted matrix  $X'_c$  of the partial indicators of socio-economic potential in the form of:

$$X'_c = \begin{bmatrix} x'_{11} & x'_{12} & \dots & x'_{1n} \\ x'_{21} & x'_{22} & \dots & x'_{2n} \\ \dots & \dots & \dots & \dots \\ x'_{m1} & x'_{m2} & \dots & x'_{nn} \end{bmatrix} \quad [7]$$

Diagnostic features are expressed in various non-additive measurement units. In order to compare the studied characteristics they ought to be normalized. Statistic data which have been normalized put on unitless values. So the adjusted matrix of observations  $X'_c$  is transformed into the matrix of standardized partial observations of the indicators of the potential<sup>18</sup>:

$$Z_c = \begin{bmatrix} z_{11} & z_{12} & \dots & z_{1n} \\ z_{21} & z_{22} & \dots & z_{2n} \\ \dots & \dots & \dots & \dots \\ z_{m1} & z_{m1} & \dots & z_{nn} \end{bmatrix} \quad [8]$$

while:

$$z_{ik} = \frac{x'_{ik} - \bar{x}_k}{S_k} \quad [9]$$

<sup>15</sup> A. Niedźwiecki, *Analiza taksonomiczna jako narzędzie oceny potencjału społeczno – gospodarczego województw*, [in:] E. Bojar, J. Kurys (ed.), *Zróźnicowanie i współpraca regionów w integracji europejskiej*, Politechnika Lubelska, Lublin 2002, p. 70.

<sup>16</sup> H. Ponikowski, *Wstępna zbiorcza...*, op. cit., p. 11.

<sup>17</sup> A. Niedźwiecki, *Analiza taksonomiczna...*, op. cit., p. 70; See. I. Roeske-Słomka, *Syntetyczne mierniki rozwoju społeczno-gospodarczego miast wojewódzkich*, [in:] „Wiadomości Statystyczne”, GUS i PTS, 2003, No. 3, p. 72.

<sup>18</sup> A. Niedźwiecki, *Analiza taksonomiczna...*, op. cit., p. 70; H. Ponikowski, *Wstępna zbiorcza...*, op. cit., p. 11.

where:

$z_{ik}$  – normalized  $k$ -th feature for  $i$ -th item (city in subsequent years),  $x_{ik}$  – original value of the  $k$ -th feature for  $i$ -th object,  $\bar{x}_k$  and  $S_k$  are respectively arithmetic mean and standard deviation of the  $k$ -th characteristic calculated according to formulas [3] i [4].

This method of transformation causes that standardized characteristics are unitless values, the arithmetic mean of all the new variables equals zero whereas variance and standard deviation always equal one. Therefore we can consider the equal importance of the influence of the examined characteristics on the level of development of complex phenomena<sup>19</sup>.

The second stage involves the construction of synthetic measurements obtained in each of the subcomponents. This task is achieved by making a synthesis of all the sub-indices or partial indicators which are considered to be diagnostic<sup>20</sup> by creating one indicator of the level of development  $W_i$ , which can take values from the interval  $\langle 0,1 \rangle$ . The higher the value is, the greater potential the city represents in the particular year<sup>21</sup>.

$$W_i = \frac{\sum_{k=1}^n z_{ik}^*}{\sum_{k=1}^n \max_i [z_{ik}^*]} \quad [10]$$

where: 
$$z_{ik}^* = z_{ik} + |\min_i [z_{ik}]| \quad [11]$$

In the last third stage aggregation of the subcomponents was conducted into components and then components into one indicator of the socio-economic potential of the city. The features were written in the following matrix:

where: 
$$X = \begin{bmatrix} x_{1E} & x_{1S} & x_{1T} \\ x_{2E} & x_{2S} & x_{2T} \\ \dots & \dots & \dots \\ x_{mE} & x_{mS} & x_{mT} \end{bmatrix} \quad [12]$$

$X$  – the matrix of diagnostic features of the socio-economic potential of the city,  $x_{ik}$  – elements of matrix  $X$  constitute the value of the examined features for  $i$ -th ( $i=1,2,\dots,m$ ) object (city in the studied year) and  $k$ -th ( $k=1$ -economic potential, 2-social potential, 3-technical potential) of the feature of development.

The aggregation was performed through the standardization of the variables according to formula [9] and then a relative synthetic indicator of the level of

<sup>19</sup> H. Ponikowski, *Wstępna zbiorcza...*, op. cit., p. 12.

<sup>20</sup> W. Kosiedowski, *Teoretyczne problemy...*, op. cit., p. 42.

<sup>21</sup> A. Niedźwiecki, *Analiza zróżnicowania międzyregionalnego jako narzędzie planowania finansowego w banku detalicznym*, [in:] D. Zarzecki (ed.), *Zarządzanie finansami, klasyczne zasady- nowoczesne narzędzia*, volume 1. ECONOMICUS, Szczecin 2002, pp. 402-403.

socio-economic development was specified for each year. It can take values from the interval  $<0;1>$ , according to formulas [10] and [11]. Synthetic taxonomic measure calculated in the end measures the socio-economic potential of the city during a given period in a multidimensional way.

### **Set of features applied**

The socio-economic potential of a territorial unit determines many interdependent traits of the development which may have different impact direction. Development features as such cover only some aspects of the potential of the city. In the statistical multidimensional analysis the features (variables) are meant to build synthetic measures of the potential which characterize the level of development in an aggregate way. It should be remembered that too many features chosen can cause disruption or even blocking of the ability of effective classification of the objects<sup>22</sup>.

The features of economic development: total income per resident, own revenue to total revenue, total expenses per one resident, investment capital expenditures to total expenditures, expenditures on public administration to total expenditure, the total of entities to population, entities – private sector to the total, entities with the participation of foreign capital to the total, the total of the employed to 1 thousand people, the unemployed to the population at productive age.

The features of social development: the density of population per 1 km<sup>2</sup>, population at productive age to the total, population after the productive age to the total, birthrate per 1 thousand people, balance of migration per 1 thousand people, balance of external migration per 1 thousand people, expenditures on education to the total of expenditures, expenditures on culture and national heritage preservation to the total of expenditures, expenditures on health care to the total, expenditures on welfare and other tasks within social policy to the total of expenditures, expenditures on physical education and sport to the total expenditures, legally protected areas in relation to the acreage, natural monuments per 1 km<sup>2</sup>.

The features of technical development: municipal roads with hard surface expressed in kilometres per 100 km<sup>2</sup>, water supply - the length of the active distribution network in km per 100 km<sup>2</sup>, population using water supply to the number of people, sewage system in kilometres per 100 km<sup>2</sup>, the number of people using the sewage system compared to the population, gas network in km per 100 km<sup>2</sup>, gas customers to the population, people using wastewater treatment plant compared to the population, markets per 100 km<sup>2</sup>, the number of pharmacies per 100 km<sup>2</sup>, the expenditures on municipal services and environmental protection to the total expenditures, the expenditures from the municipal budget on transportation and communication to the total of

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<sup>22</sup> A. Zeliaś, *Some Notes on the Selection of Normalization of Diagnostic Variables*, Statistics in Transition, vol. 5, No. 5, 2002, pp.787-802.

expenditures, year-round accommodation places in the tourist facilities of collective accommodation, tourist collective accommodation facilities, the total of accommodation places provided, the total of accommodation places provided to the foreign tourists in comparison to the total, usable area of housing to the number of residents, the number of rooms to the number of people, expenditures on housing economy to the total of expenditures.

The final result of the conducted typology is determined by the selection of indicators which is always a subjective decision and the correctness of this very important stage is dependent on the knowledge and experience of the researcher. Whilst choosing the variables were used the works of researchers such as: P. Swianiewicz<sup>23</sup>, M. Jerczyński<sup>24</sup>, M. Ziółkowski<sup>25</sup>, F. Wysocki, A. Łuczak<sup>26</sup>, H. Ponikowski<sup>27</sup>, T. Tokarski, W. Stepień, J. Wojnarowski<sup>28</sup>, A. Malina, P. Malina<sup>29</sup>, A. Młodak<sup>30</sup>, J. Lira and F. Wysocki<sup>31</sup>.

The information concerning the characteristics describing the socio-economic potential of a city come from the Regional Data Bank run by Central Statistical Office. The information can be accessed on the website [www.stat.gov.pl](http://www.stat.gov.pl).

## The results of analysis

On the basis of analysis of the economic component it can be stated that the level of it has increased in the studied period (chart 1). The trend in the examined period is growing. A minor decrease in the level of the economic component can be observed between 1997 and 1998 as well as 2001 and 2003.

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<sup>23</sup> P. Swianiewicz, *Spoleczno-ekonomiczna typologia miast i gmin w Polsce*, Uniwersytet Warszawski, Warszawa 1989, pp.33-38.

<sup>24</sup> M. Jerczyński, *Metody pośrednie identyfikacji i pomiaru bazy ekonomicznej miast*, [in:] K. Dziewoński, M. Jerczyński, *Baza ekonomiczna i struktura funkcjonalna miast*, PWN, Warszawa 1971, pp.111-135.

<sup>25</sup> M. Ziółkowski, *Dysproporcje w zagospodarowaniu infrastrukturalnym gmin województw Polski środkowo-wschodniej*, [in:] W. Rakowski [ed.], *Przemiany społeczno-ekonomiczne Polski w układzie przestrzennym w latach 1989-1994*, Szkoła Główna Handlowa, Warszawa 1997, pp. 101-124.

<sup>26</sup> F. Wysocki, A. Łuczak, *Ocena poziomu rozwoju społeczno-gospodarczego obszarów wiejskich Wielkopolski*, [in:] J.J. Parysek (ed.), *Rozwój regionalny i lokalny w Polsce w latach 1989-2002*, Uniwersytet im. Adama Mickiewicza w Poznaniu, Bogucki Wydawnictwo Naukowe, Poznań 2004, pp. 317-329.

<sup>27</sup> H. Ponikowski, *Asymetria stymulant i destymulant konkurencyjności województwa lubelskiego*, [in:] E. Bojar, J. Kurys, *Zróźnicowanie i współpraca regionów w integracji europejskiej (ze szczególnym uwzględnieniem władz lokalnych i regionalnych)*, Wydawnictwo Politechniki Lubelskiej, Lublin 2002, pp. 57-65; H. Ponikowski, *Wstępna zbiorcza analiza taksonomiczna poziomu rozwoju powiatu lubartowskiego i jego gmin*, [in:] Raport końcowy usługi „Planowanie Rozwoju Lokalnego” Moduł C „Studium Lokalnego Potencjału Gospodarczego Powiatu Lubartowskiego, Centrum Kształcenia Menedżerów Przemysłowych, Lublin, 2004 , pp. 11-25.

<sup>28</sup> T. Tokarski W. Stepień, J. Wojnarowski, *Zróźnicowanie poziomu rozwoju społeczno-ekonomicznego województw*, [in:] „Wiadomości Statystyczne”, GUS i PTS, 2006, nr 7/8, pp. 87-89.

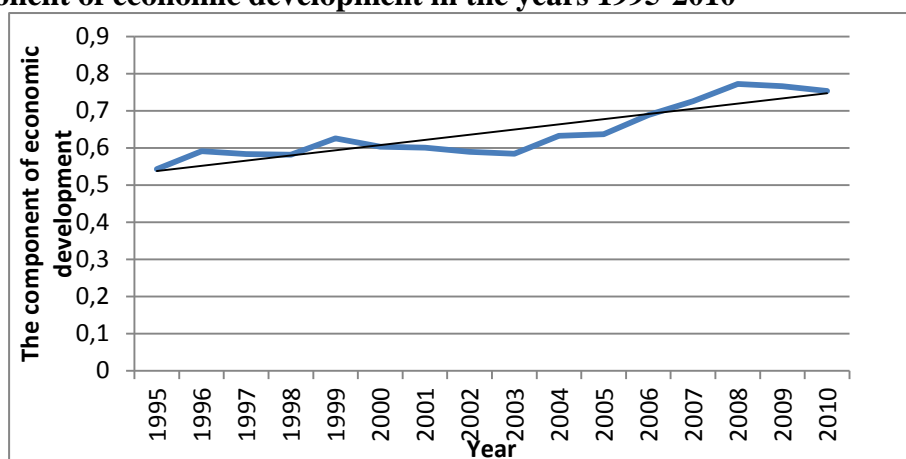
<sup>29</sup> A. Malina, P. Malina, *Determinanty rozwoju regionalnego Polski*, [in:] „Wiadomości Statystyczne”, GUS i PTS, 2005, No. 10, pp. 69-71.

<sup>30</sup> A. Młodak, *Ocena zmienności cech statystycznych w modelu taksonomicznym*, [in:] „Wiadomości Statystyczne”, GUS i PTS, 2005, No. 9, pp. 12-13.

<sup>31</sup> J. Lira, F. Wysocki, *Zastosowanie pozycyjnego miernika rozwoju do pomiaru poziomu zagospodarowania infrastrukturalnego powiatów*, [in:] „Wiadomości Statystyczne”, GUS i PTS, 2004, No. 9, pp. 42.

Chart 1

**The component of economic development in the years 1995-2010**

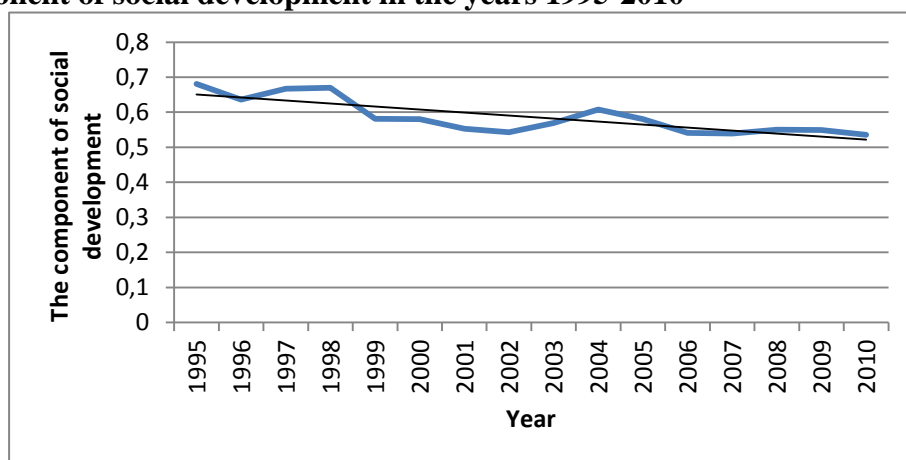


Source: Own research

The component of social development represents the decreasing trend (chart 2). Minor fluctuations in the social component can be observed around the trend. Decline in the social component is caused by the demographic situation of the city which can be regarded as the problem area.

Chart 2

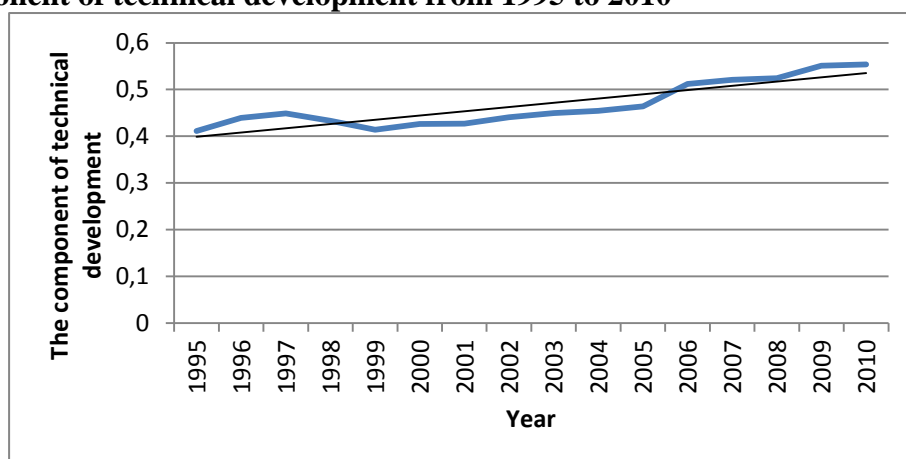
**The component of social development in the years 1995-2010**



Source: Own research

Chart 3

**The component of technical development from 1995 to 2010**



Source: Own research

Table 1

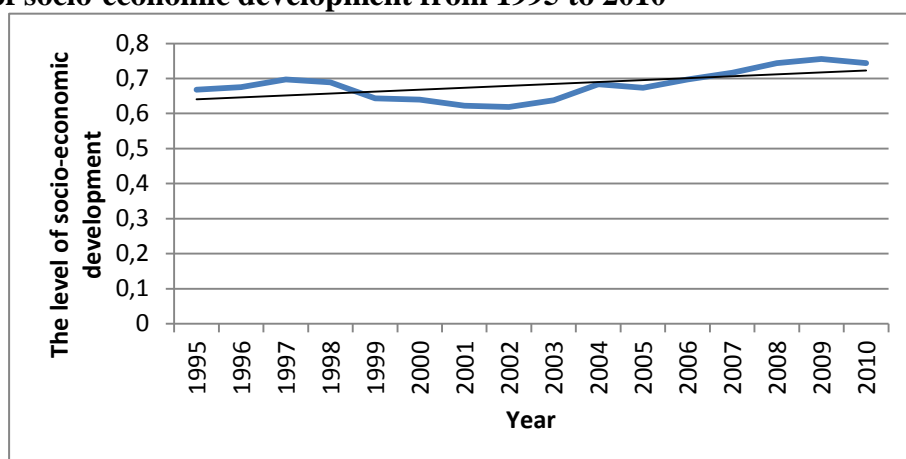
**The correlations between the components of the development**

	Economic component	Social component	Technical component
Economic component	1	-	-
Social component	-0,67	1	-
Technical component	0,94	-0,60	1

Source: Own research

Chart 4

**The level of socio-economic development from 1995 to 2010**



Source: Own research

The component of technical development in the studied period represents a growing trend (chart 3). A slight decrease in the technical potential can be observed in 1998 and 1999 and then an increase from 2000 to 2010.

Studying the correlations between the components we can state that the social component is statistically significantly negatively correlated with both



economic and technical components. This means that whereas the level of economic and technical components increases, the social component decreases.

Having performed aggregation of the examined components, the level of socio-economic development of the city of Lublin from 1995 to 2010 was obtained (chart 4). The level of growth increases between 1995 and 1998, from 1999 to 2002 it drops and then from 2003 to 2010 it rises again. The trend of the level of socio-economic development is increasing in the examined period.

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# BUSINESS PERFORMANCE AND BALANCED SCORECARD

## VÝKONNOSTĚ PODNIKU A BALANCED SCORECARD

*Martina SABOLOVÁ – Lenka ŠTOFOVÁ*

### Abstract

Company needs to evaluate the business performance via company processes to maximize profits and increase the value of company. Businesses need to know its performance in several aspects and indicators. For the evaluation of business performance, there are many methods and many indicators. In fact, many methods and tools does not provide accurate results and are also often misleading. Therefore, in this paper we focus on multi-criteria performance evaluation based on selected methods and using the Balanced Scorecard.

### Keywords:

performance evaluation, Balanced Scorecard, multicriterial evaluation, Aligned Balanced Scorecard

### Abstrakt

Aby podnik mohl maximalizovat zisk a zvyšovat hodnotu podniku, potrebuje hodnotit výkonnost podniku a jeho procesov. Podniky potrebují poznat svou výkonnost z viacerých hľadisk a ukazovateľov. Na hodnotenie výkonnosti podniku existuje mnoho metód a mnoho ukazovateľov. V skutočnosti však mnoho metód a nástrojov neposkytuje presné výsledky a mnohokrát sú i zavádzajúce. Z tohto dôvodu sa budem v tomto príspevku zameriavať na multikriteriálne hodnotenie výkonnosti n základe vybraných metód a s využitím Balanced Scorecard.

**Kľúčové slová:** hodnotenie výkonnosti, Balanced Scorecard, multikriteriálne hodnotenie, upravená Balanced Scorecard

### Introduction

Balanced Scorecard (BSC) was designed in the 90s 20 century as a revolutionary idea to measure business performance by David Norton and Robert Kaplan.<sup>32</sup>

The term "Balanced Scorecard" so called "Balance sheet card" is a concept of a balanced system evaluation indicators, which aims to achieve a comprehensive "balance" and this in several ways: between short-term and long-term goals, values and indicators in kind, between late indicators and drivers, between internal and external performance factors.<sup>33</sup>

This strategy has become a milestone in the ability to express criticism of value (financial) criteria for measuring business performance and to assess the success of its survival in the future. BSC approach is used by many companies abroad, with positive results. Some reports estimate that 40% of the top 1000

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<sup>32</sup> NIVEN, P.R.: *Balanced Scorecard Diagnostics* (Maintaining Maximum Performance), 2005. Publishing: John Wiley & Sons, Inc., 206p. ISBN 13-978-0-471-68123-7

<sup>33</sup> FIBÍROVÁ, L., ŠOLJAKOVÁ, L.: *Hodnotové nástroje řízení a měření výkonnosti podniku*. 1. Publishing. Praha: ASPI, a.s., 2005. 263s. ISBN 80-7357-084-X.

foreign companies have used some form of BSC. Unfortunately studies to support the effectiveness of the BSC approach have not been well documented. BSC approach has been adapted to meet a variety of business applications, but measuring the effectiveness of the company in a controlled environment is difficult. While the BSC approach has not been evaluated by means of statistical methods, hundreds of studies and researches using statistical method for efficiency objectives. Approach aligned BSC (ABS) has two dimensions for setting goals and objectives in the organizational alignment unit and interconnection of components through the hierarchy of objectives in the company.

The Balanced Scorecard tool has promoted strategic changes that serve primarily to top management and gradually develop downwards, to all business units. Fast and surface deployment of BSC usually does not lead to success. A little known fact is that the successful deployment assumes the existence of a working process and information infrastructure in the operational and tactical business management. Otherwise recalls as "selling vacuum cleaners where they do not have electricity." This method is one of the most respected approach in linking company vision, strategic objectives to operational planning and decision-making<sup>34</sup>.

This article supports the use of the Balanced Scorecard and ABS as a tool to improve business performance. First, we will focus on the development and characteristics of the BSC, and then mention some current issues BSC. Consequently, we propose to use ABS as the possibility of linking business strategy to its performance. In the last part of the article explains the advantages in the use and implementation of ABS, which leads to improved individual as well as corporate performance.

### **Characteristics of Balanced Scorecard**

BSC methodology is a useful tool for creating and implement the strategy. Significantly contributes to linking human resource management system and enterprise management system, thus combining business strategy to human resource management. Outside, it also provides a "language" to communicate the vision and strategy across the enterprise, at all levels and is a useful communication tool in the debate about strategy and opportunities to achieve the highest goals. It is not enough to have a clear vision and strategy of the company, but it is necessary to prove it clarified.

To be a successful strategy it must be well understood and connected in order to all parts of the company to each employee. This methodology helps to align business strategy with the implementation of its culture, lightens the

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<sup>34</sup> SABOL, J. – TKÁČ, M.: *Multikriteriálne hodnotenie výkonnosti a Balanced Scorecard*. 2012. In: *Výkonnosť podniku*, roč. II, č.2. Výskumný ústav ekonomiky a manažmentu. ISSN: 1338-435X

understanding of business strategy on the part of employees and increases their motivation<sup>35</sup>.

BSC consists of four major perspectives (viewpoints) of financial, customer, internal business process perspective and learning and growth. The financial perspective is mainly engaged in monitoring and evaluating financial indicators such as cash flow and so on. Customer perspective monitors indicators that are important to the customer, the price and quality of products, services related to product and of course the customer satisfaction. Object of monitoring process perspective are called critical processes, that directly affect the customer's satisfaction. These processes are measured, and determining the extent of their effectiveness. Perspective of learning and growth (education and innovation, or potential) is trying to delimitation between company characteristics necessary for its constant progress, to attain all the objectives and the ability to adapt well to the business to external and as well internal changes<sup>36</sup>.

This approach causes a transform business vision into the company activities that support the required business performance. Company sets goals, measures for each of the four sections with a focus on the following four questions:

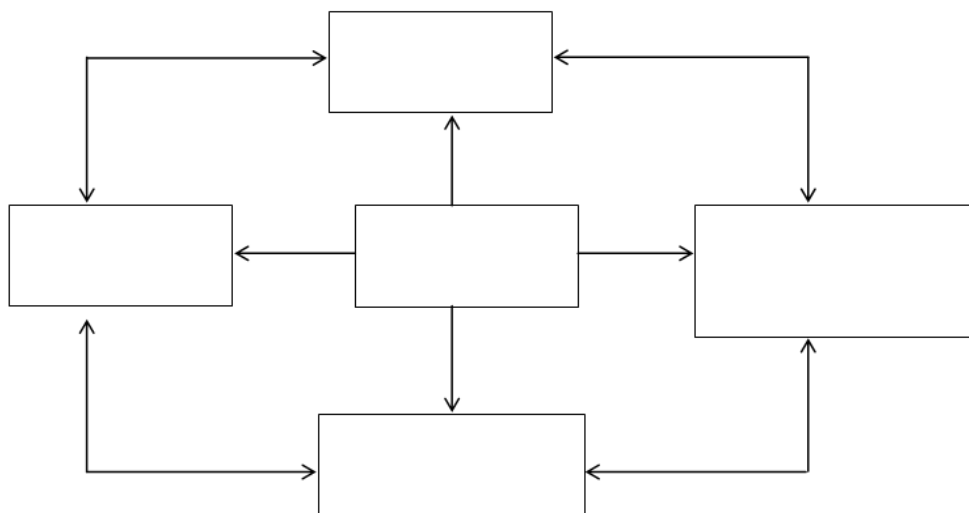
1. Financial: how do we look to our shareholders?
2. Customer: how customers see us?
3. Internal business processes: What must we excel at?
4. Learning and growth: Can we continue to improve and create value?

Coverage of each of these four perspectives the organization is achieving a more balanced view of what is necessary to take into account the effective development of the strategic plan.

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<sup>35</sup> VODÁK, J. – KUCHARČÍKOVÁ, A.: *Efektivní vzdělávání zaměstnanců*. 2007 Grada Publishing a.s. Praha, s.16 ISBN 80-247-1904-7

<sup>36</sup> KAPLAN, R.S. – NORTON, D.P.: *Balanced Scorecard: Strategický systém měření výkonnosti podniku*, 2002. Praha: Management Press. ISBN 80-7261-063-5



**Scheme 1**

Scheme of Balanced Scorecard according to Norton and Kaplan

Source: KAPLAN, R.S. – NORTON, D.P.: *Balanced Scorecard: Strategický systém měření výkonnosti podniku*, 2002.

## Composition of Balanced Scorecard

Balanced Scorecard is a sophisticated and comprehensive measurement tool of business performance. Since it was created is quite often applied in the corporate practice.

The basic elements of the Balanced Scorecard include:

### 1. Vision and Strategy

Vision is creating the future ". We tell ourselves hoe we would like to see our business. In this context it is appropriate to note that creating a vision does not lie in making plans and budgets. The vision is a future conduct of business. The strategy is to determine the long-term direction of the company. Managers do not have it on the table or in a drawer as a written document. If vision is the goal then strategy is the way to that goal.

Goals of individual perspectives are logically derive from financial goals. Financial objectives are directed to objectives in the customer area, affecting the objectives of a business process perspective (which enables to discover which processes are key and which will have to be formed) and from the objectives of the business process are subsequently deducted objectives for learning and growth or we can formulate in the opposite direction<sup>37</sup>:

- Perspective of learning and growth conditional on performance in perspective of internal processes,
- The perspective of internal processes determines the performance of the customer perspective,
- Customer perspective determines how the company will thrive in the financial perspective.

<sup>37</sup> KOŠTAN, P. – ŠULEŘ, O.: *Firemní strategie – plánování a realizace*. 2002. Computer Press, s. 116. ISBN 80-722-6657-8.

For each of the four perspectives managers need to determine critical success factors. It represents the key area whose correct functioning and satisfactory results at all times ensure the successful operation of the company in a competitive environment and fulfillment of their resolutions and conclusions. Judging individual critical factors will verify if unfulfillment of one of them causes unfulfillment of the mission.

## 2. *Perspectives*

The basic model includes four perspectives. Company in defining Balanced Scorecard may be complemented by some other perspective. By its direction the company can supplement the perspective, for example, to emphasize human resources for business success. Some companies included in its personnel perspective, but some companies consider that the personnel area is included in the perspective of learning and growth (education and innovation).

## 3. *Measurements*

Measurements linking strategy and actions (activities) that will achieve strategic objectives. They are quantitative description of indicators that company wants to achieve or variables that affect its operation. Not all measurements belong to the BSC. BSC helps the company to focus on measurements that are essential to its success. It's something that the company can constantly improve. After accumulating sufficient feedback from business activities and the employees company can modify measurements to create a better picture of objective reality.<sup>38</sup>

### **Measurement of business performance via BSC**

We can improve only what is measurable. BSC method makes demands of careful measurement of business performance in all four perspectives. Every perspective of BSC must have<sup>39</sup>:

- precise objectives, numerically (e.g. acquiring 200 new customers, training 30 people in the BSC method, etc..),
- selected indicators in which these objectives will be expressed, and thus can be quantitatively controlled,
- induced and effective use own initiative of employees at all levels, appropriate to management,
- it is also necessary to elaborate a set of measures to achieve the targets, respectively management plans.

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<sup>38</sup> SABOL, J. – TKÁČ, M.: *Multikriteriálne hodnotenie výkonnosti a Balanced Scorecard*. 2012. In: Výkonnosť podniku, roč. II, č.2. Výskumný ústav ekonomiky a manažmentu. ISSN: 1338-435X

<sup>39</sup> GAVUROVÁ, B.: *Význam Balanced Scorecard pre meranie a riadenie výkonnosti podniku*. 2007. SEMAFOR'07 Košice, Ekonomika firiem 2007. ISBN 978-80-225-2392-9

Regarding the financial perspective and the perspective of internal business processes we talk about improvement and completion of performance indicators. A little more challenging in customer and employee perspective (learning and growth) because assessment of indicators in them is more difficult for businesses. For the creation of a balanced system of indicators of business performance should be equivalent to performance indicators and interdependent.

## **Methods of multicriterial performance evaluation**

We are faced with multicriterial evaluation methods especially in intercompany comparisons, when financial analyst focuses on analyzing the status of the company market and obtain representative results for determining whether a place of business in the market space. Multicriterial evaluation methods represent one group of prediction methods within the financial analysis of ex-ante. Multicriterial evaluation methods represent a combination of different approaches of expert evaluation, mathematical and statistical methods, graphical methods. The aim is to most accurately analyze the financial and economic situation of the company and, consequently, predict its future.<sup>40</sup>

### ***Decision Matrix Method – DMM***

It is considered as the basic method (can have multiple solution options). One option consists in evaluating weight (importance) of each criterion point scale from 1 to 10 so that level 1 is assigned the smallest weight and gain the greatest level of 10. Same scale was also evaluates fact that, each variant solutions meet selected criteria, i.e. degree of "1" - did not match up to "10" - ideal conform.

For the final criterion for the decision shall be elected by the largest weighted sum (sum of conjunctions of evaluation compliance criteria and their weights). The advantage is the simplicity of the procedure and relatively low time-consuming. The disadvantage is a high proportion of subjectivity - the valuation criteria and weights in assessing how individual variants meet the selected criteria.

### ***Forced Decision Matrix Method – FDMM***

This method partially eliminates the disadvantages of DMM. Weighting of each criteria, as well as an evaluation of options how they satisfy the individual criteria are determined paired comparison. This means that when we are comparing the two criteria is significant (important for decision making) criterion evaluated "1", minor criterion of "0". Similarly, when we are evaluating how the two variants satisfy selected criteria of evaluation is satisfactory variant better, evaluated "1" and variations rated worse "0".

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<sup>40</sup> LESÁKOVÁ, Ľ A kol. 2007. *Finančno-ekonomická analýza podniku*. Banská Bystrica: Univerzita Mateja Bela, Ekonomická fakulta, 82 s. ISBN 978-80-8083-379-4



The resulting evaluation of options or weighting of criteria we get that evaluation "standardize", i.e. we require that the sum of all evaluations respectively weights was equal to 1. The advantage is the relative simplicity of the procedure and remove subjectivity in determining the weights of criteria and impact (intended more exact).

The disadvantage is relatively large differences between options and criteria (although they differ only slightly) and in determining the weight criteria or evaluation alternatives equal to 0, not the overall assessment of any impact.

### ***Analytic Hierarchy Process – AHP***

AHP to some extent eliminates gaps of DMM and FDM. It is also based on pairwise comparison of the degree of importance of the individual criteria and the extent of how evaluated alternatives can satisfy these criteria. Evaluation scale is much more complex. Evaluation in both cases (comparison criteria and variants) based on expert estimates, where experts in the given field of interaction, comparing two factors. These values based on the same scale - light - medium - strong - very strong], and this verbal Answer rating values [1-3-5-7-9].

BSC methodology does not say exactly about the use and exploitation of these methods, but for performance evaluation of companies, it is necessary to use some of the methods of evaluation. BSC has some shortcomings, which included the issue of aggregation of data at higher levels in the hierarchy of the model performance evaluation. Not all businesses trust conclusions from the BSC methodology, therefore, this issue is currently engaged in research organizations in order to find the correct answer, which would be able to objectively evaluate the performance of the company.

### **Importance and relationships of BSC**

BSC methodology is looking for value metrics of business performance, which aim is not substitution of measuring business performance through profit via other criteria. These values are indicators of output indicators that reflect a common objective and can be regarded as indicators of late.

BSC concept considers the value criteria for irreplaceable due to their objectivity (as verified by market) and synthetic (it is the aggregate result of the transformation process of business). However the aim is to remove distortion of value indicators caused its monitoring in the short term, due to the comparability of revenues and expenses in the changing conditions of the competitive environment.<sup>41</sup>

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<sup>41</sup> FIBÍROVÁ, L., ŠOLJAKOVÁ, L.: *Hodnotové nástroje řízení a měření výkonnosti podniku*. 1. Vydání. Praha: ASPI, a.s., 2005. 263s. ISBN 80-7357-084-X

A key element of BSC reflecting causality and logic of strategic considerations is a compilation of the chain of cause and effect. Necessity is the focus only on strategically important chains of cause and effect.

The following figure is an illustration of the causes and consequences of different perspectives.

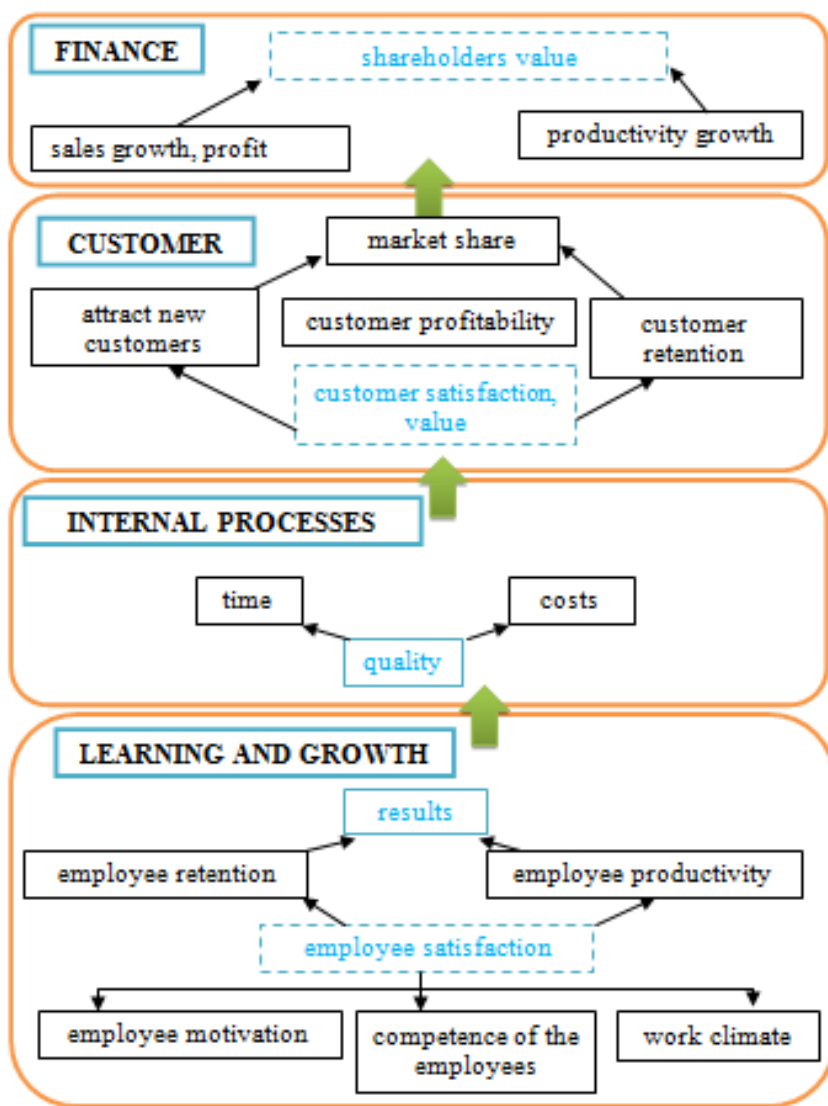


Figure 4

#### Realationships in BSC

Source: Own processing

The authors of the concept of Balanced Scorecard R. Kaplan and D. Norton suggested 10 years after first publication of the BSC accurate procedure for the strategic management of business performance. The new system - strategic map transforms the original system performance measurement to strategic management. Strategy maps enable<sup>42</sup>:

<sup>42</sup> FORT, J. a kol.: *Tvorba strategie a stategické plánování*. 2012 Grada Publishing, a.s. Praha, s.118 ISBN 978-80-247-3985-4

- refine the strategic business development plan and facilitate its negotiations with employees,
- identify the key internal processes that lead to the success of the organization,
- use effective investments in people, technology and organization required in order to ensure the planned business objectives.

This model describes how to achieve goals and increase the value of the company. Four remain promising targets under the old system BSC. Measurement is not just the performance indicators within individual perspectives, but also follows a series of cause-effect relationships between different perspectives.

The strategic map is a tool that tells how is value made in the organization. Strategic map shows the linking of specific strategic objectives. It shows how the development objectives in the field of learning and growth allows an organization to improve and develop their goals in business processes, which in turn will allow the objectives and create value for customers.<sup>43</sup>

## **Implementation of BSC**

In order for businesses implement the BSC is necessary support from the top management and adaptation company activities, appropriate new governance. The creation of the company that will be able to flexibly adapt strategies, it is necessary to interface with management control systems. The problem lies mainly in the BSC incompatibility with the existing management system which is focused on hierarchical and functional organizational structure, while the content and structure of the BSC addresses simultaneously more organizational units.

Implementation process of BSC may take different lengths of time, it depends primarily on the specific conditions of the company. As stated by the founder of BSC Kaplan at 5th Forum "Basler Balanced Scorecard" implementation time of BSC depends primarily on the size of the company. For very large companies (about 300 employees) that usually have one BSC throughout the company is further time required, which can utilize up to 3 months. For other processes such as communication, a new reporting system, adapting personal goals you need about 6-9 months. In larger companies the process can take two years.<sup>44</sup>

## **Problems in the application of BSC**

In fact, there are still problems with the effective application of the Balanced Scorecard. These problems are focused on four main issues and the lack of understanding of the importance of processes within the company; lack of

<sup>43</sup> ŘEPA, V.: *Procesně řízená organizace*. 2012 Grada Publishing, a.s. Praha, s. 63 ISBN 978-80-247-4128-4

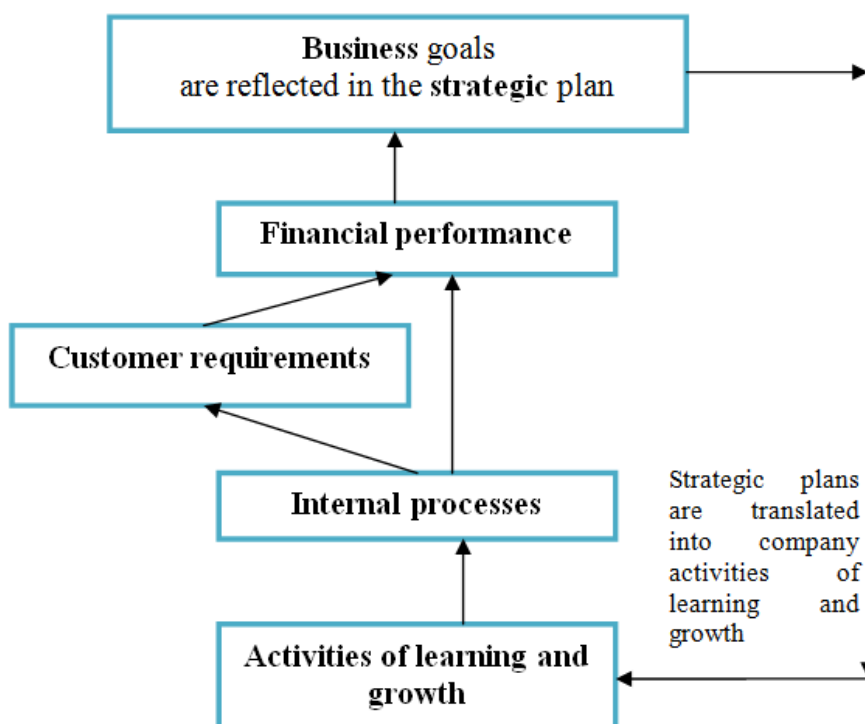
<sup>44</sup> KISSELEFF, I.: *Das echte Geheimnis liegt in der Umsetzung von Strategien*. In *Moderní řízení*, 2006, č.11, s. 22-24. ISSN 0026-8720

understanding on the clearance between items within the scorecard, the need for appropriate metrics and the need to understand how it affects corporate strategy scorecard. Aligned Balanced Scorecard (ABS) proposes solutions to these four problems mentioned above. ABS enhances the benefits scorecard and enhances its usefulness.

The proposed augment of the BSC applies Baldrige conception of organization and leadership of internal processes as the main drivers of organizational financial performance and objectives of customer satisfaction. Organizational goals are reflected in the strategy as a means to achieve the desired goals. Strategies are converted into action plans, which are converted into the activities of learning and growth process improvement. Improve internal processes is a key instrument affecting customer requirements and improves the financial performance of the company.

Fulfillment of customer requirements is an important activity for the long-term sustainability of the organization, improve the future financial performance of the company by satisfying customers who tell other people about their positive experiences. Improvement of financial performance is directly related to the achievement of strategic plans, which in turn support the achievement of overall business objectives. ABS combines each element into a cohesive modified plan, which supports the fulfillment of business objectives and provides key measures business performance measurement.

Scheme 2 gives us an overview of the aligned BSC.



Scheme 2  
**Aligned BSC**

*Source: Own processing*

## **Benefits of using ABS - better tool for management**

ABS has improved the traditional BSC in five ways:

1. ABS focuses on the importance of processes, a savoir, to understand how to manage the activities of the company,
2. ABS supported by causal consistency between elements in the company, such as the relationship between the degree of process performance and customer satisfaction and financial results,
3. ABS emphasizes the importance of establishing of appropriate metrics for the evaluation of all areas of ABS,
4. ABS submit the proposed strategy activities into learning and growth in order to improve key processes in the organization that are directly linked to the achievement of organizational goals,
5. ABS provides a different way of looking at leadership in the management of people processes and supports high performance business.

## **Conclusion**

Balanced Scorecard is a strategic tool for measuring business performance. It represents a modern method of strategic management, which allows to develop all the important assets in the company. For efficient use of the BSC at performance management is necessary to connect different perspectives i.e. perspectives by defining relationships between indicators, which is not an easy task. The implementation of BSC in the company is effective when will force the company management clearly define the objectives and look for possibilities to achieve them, in order to achieve permanent existence of the company.

So that the company could do so, you need powerful software equipment, which clarify and simplify the process of creating BSC model. If the company decides to invest in this solution it should be decided according to the functionality that application software to BSC offers in various phases of implementation of the project, but then at the time of use. Whereas, from the perspective of company processes are an essential source of business performance evaluation, it is necessary to deal with them more deeply.

It is not enough that we describe and show in the form of a flowchart, but we must also look at the inside i.e. properties and characteristics, which are necessary to measure and evaluate their performance. If we want to achieve that the system for measuring and evaluating the performance of business process become its real and credible management tool, must be individual variables systematically compiled and created appropriate mathematical methods and procedures to the needs of strategic management and managerial work.

ABS, as can be seen in figure 2, is becoming more used tool in companies compared with traditional BSC. ABS becomes a management tool, which clarifies the relationship between internal business processes and desired business objectives. Development and education aimed at improving these

processes to increase organizational performance. ABS provides access to top management understanding of how to organize processes and how to improve employee motivation to have the greatest impact on the company. Application of the ABS system creates powerful centralized work environment oriented to management, contributes to the health and vitality of the corporate culture and improving work results.

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# ECOLOGICAL AND ECONOMIC PRINCIPLES OF SUSTAINABLE DEVELOPMENT OF THE CARPATHIAN EUROREGION

## ЕКОЛОГО-ЕКОНОМІЧНІ ЗАСАДИ СТАЛОГО РОЗВИТКУ КАРПАТСЬКОГО ЄВРОРЕГІОНУ

*V.V. KHIMINETS – Ján HOLONIČ*

### **Abstract**

The article represents ecological-economic problems of Carpathian Euroregion. The main ecological-economic mechanisms of implementation of the concept of sustainable development of the Carpathian Euroregion were considered. Actuality and importance of active and effective interregional ecological-economic cooperation in the Carpathian Euroregion is substantiated. Evaluating the environmental situation, author shows, that character features for all Carpathian regions are significant anthropogenic landscape transformation and contamination of environment.

### **Keywords:**

sustainable development, the Carpathian Euroregion, environmental economics.

### **Анотація**

У статті проаналізовані еколого-економічні проблеми Карпатського Євросереєгону. Розглянуто основні еколого-економічні механізми реалізації концепції сталого розвитку Карпатського Євросереєгону. Обґрунтована актуальність і важливість активного та ефективного міжреєонального еколого-економічного співробітництва в Карпатському Євросереєгону. Оцінюючи екологічну ситуацію, автор показує, що для всіх країн-членів Карпатського євросереєгону характерне істотне антропогенне забруднення ландшафту і навколишнього середовища.

### **Ключові слова:**

сталий розвиток, Карпатський Євросереєгон, економіка природокористування.

### **Introduction**

The problems of border territories, interterritorial and cross boarder cooperation in Ukraine were first investigated in the end of 1980s. Research studies are being conducted by many Ukrainian scientists, for example O.Amosha, P.Belenkiy, Z.Varnaliy, M.Dolishniy, Ye.Kish, M.Kozoriz, M.Lendyel, N.Lutsyshyn, A.Melnyk, V.Miklovda and by such foreign scientists, as P.Eberkhard, R.Fedan, T.Komornitski, T.Liyevski, Z.Makyela, M.Rostishevski, A.Stasyak, Z.Zyolo (Poland), I.Shuli-Zakar (Hungary), B.Borisov, M.Iliyeva (Bulgaria), S.Romanov, V.Bilchak, L.Vardomskiy, Yo.Zverev (Russia), P.Kuzmin, Yu.Tey (Slovakia), D.Villers (Germany), P.Patti, G.-M.Chudi (Switzerland) etc. A range of investigative problems mainly concerns certain frontier territories and practical activities of Euro regions. The



first works have been used in the establishment of “the Carpathian Euroregion”, Euroregions “Buh” and “Nyzhniy Dunay”.

**1. Historical aspects.** Being founded in 1993 by frontier territorial regions of post-socialist countries, the Carpathian Euroregion includes adjoining frontier territories of Poland, Slovakia, Hungary, Ukraine and Romania and is the first euro regional initiative in the Eastern Central Europe.

International Association “The Carpathian Euroregion” (CE) was created in February 14, 1993, when ministers of Foreign Affairs of Ukraine, Poland and Hungary signed the Declaration on Cooperation of the Carpathian region residents in Debrecen (Hungary). It expresses consent of governments of these countries in formation of the Carpathian Euroregion functioning as a structure for supporting relations of long-term cooperation among them. The Carpathian Euroregion includes border administrative units of five countries - Ukraine, Poland, Hungary, Romania and Slovakia. In February 1993 the Carpathian Euroregion covered the territory of 53 200 sq. km. with a population of 5 mln. people. Later these figures increased to 161 279 sq. km. and 16 mln. people.

The territory of the Carpathian Euroregion is 161 279 sq.km, which is divided between Poland -11.5%, Slovakia - 6.4%, Romania - 27.2%, Hungary - 18.4%, Ukraine - 36.4% of the total area, and has the following parameters:

*-Ukraine*

Area - 56,660 sq. km with a population of 6,429,900 people. The territory consists of four regions, located in the western part of Ukraine: Lviv, Transcarpathian, Ivano-Frankivsk, Chernivtsi regions. Urban population is 49.8%. The largest cities are Lviv, Chernivtsi, Ivano-Frankivsk, Uzhgorod.

*- Hungary*

Area - 28,639 sq. km with a population of 2,616,000 people. The territory consists of five regions located in the north-eastern part of Hungary: Borshod-Abaúj-Zemplén; Haidú-Bihar; Heves; Yás-Nádkeresztúr-Szolnok; Szabolcs-Szatmár-Bereg; as well as cities with regional status: Miskolc; Debrecen ; Eger; Nyíregyháza with 56.5% urban population.

*- Slovakia*

Area - 10 459 sq. km with a population of 1,554,740 people. The territory consists of two regions - Presov and Kosice. In this part of the Euroregion 57.3% of the population live in urban areas, and the largest cities are: Bardejov, Humenne, Kosice, Michalovce, Presov.

*- Poland*

Area-18 683 sq. km with a population of 2,127,860 people. Territory covers Podkarpackie province that consists of 20 districts and four cities on the rights of districts. The urban population is 41%, and the largest cities are Krosno, Przemyśl, Rzeszów, Tarnobrzeg.

*- Romania (since 1997)*

Area - 42 308 sq. km with a population of 3,333,050 people. Territory consists of 7 districts: Satu-Mare, Maramorosh, Bihor, Zillah, Botoshani, Suchava, Kharhita. The urban population is 44%, and the largest cities are Oradea, Vaiya Mare, Satu-Mare, Botoshani, Zilah, Suchava.

The Agreement and the Charter being the main legal acts that regulate the Carpathian Euroregion were approved on February 14, 1993 in Debrecen (Hungary).

**The objectives of "the Carpathian Euroregion" are :**

- promoting cooperation in the economic, social, scientific, environmental, educational, cultural areas and in sports;
- lobbying and the implementation of cross-border projects, cooperation with national institutions and organizations

The main objective of the Carpathian Euroregion is to improve the living standards of the population of this region, to maintain peace, to promote good neighborly relations on both sides of the borders, to reduce isolation, to guarantee the transparency of borders.

The Carpathian Euroregion has its own budget, that includes funds of the regional and local authorities as well as the funds of foreign backers, like the Fund of Rockefeller Brothers or Research Institute "East-West".

## **2. Economic opportunities.**

In general, it can be argued that these border regions weren't considered as those which have been developing for decades till 1990. After the change of the form of government, the competitiveness of the central regions of these countries increased, and their transfer to a market economy can be regarded successful according the fact that their adaptive ability was more intensive than a similar one in the peripheries. Thus depressiveness and periphery of the regions of the Carpathian Euroregion has increased. Their social and economic backwardness – in contrast to the development of other regions - has recently become more notable. At the same time the reduction of the role of the State border and strengthening foreign relations along the border plays a vital role for underdeveloped regions of the Euroregion.

The countries that are members of the Carpathian Euroregion have a common feature - uneven regional development and its consequences. The fact is clear that the regional crisis is above all a problem for the participating governments and sociologists who also take an active part in observation of this question. Uneven regional growth is equally determined by scientists and by politicians: positive results of market economy are concentrated in a few privileged locations near centers, while peripheral regions remain without competitive advantages.

The periphery is characterized by social and regressive processes, which intensify the regional crisis. The whole territory of the Carpathian Euroregion -

regarding all members - is a periphery from the social and economic point of view.

The Carpathian Euroregions objectives were to provide an organizational structure for members in coordinating international cooperation, to promote more rapid economic and regional development and of course the creation of good relations among the participants. Main obstacles to achieve this goal is the extreme fractions of political parties of European countries, which support a strong share role of State borders and the differences between the traditions, the fiscal and financial systems and legislative systems base.

Different economic features within the region and as a result the varied social and economic development make contribution to the lack of cooperation. This is especially notable in the cross-border trade relationship where the lack of border crossings, weak financial system and bureaucracy prevent the cooperation. In addition to this the development of services associated with international relations carries significant differences between countries in the region. The State policy of centralization in many Western European countries indirectly established the primary barrier in the development of cross-border cooperation, and from this perspective, the countries of Central and Eastern Europe can be attributed to a strictly centralized. This is a key issue in the development of cross-border cooperation because local authorities are largely dependent on government structures. In general terms it can be argued that regions which belong to the Carpathian Euroregion find themselves losers in the processes of differentiation within their countries.

In the transformed Central and Eastern Europe, countries are at different stages of social and economic development, and, hence, the Carpathian Euroregion countries – are also at different levels of development, making their mutual comparison and analysis difficult. The values of gross domestic product and average wages in the regions of member countries of the Carpathian Euroregion are presented in Tables 1 and 2, respectively.

The economic recession in the member states took place in different times, and the reasons were different. The collapse of the communist political system and planned economy, the termination of previous foreign trade relations, and as a result, the shock that accompanied the political transfer, was felt in all countries. However, local features and national characteristics were carrying their own amendments in economic policy.

Economic recession manifested itself first in Poland and Hungary, as well as further productive regress. In the other three countries hesitation about privatization processes extend the duration of the transfer.

However, it may be argued that the regions belonging to the Carpathian Euroregion were less affected by industrial decline of the 1990s due to their lower level of industrialization. However, there are some sporadic metallurgical industrial areas (with obsolescent equipment), which are an exception to the

above. Agricultural areas that make up most of the Euroregion had been already retarded and the further deterioration of the situation has been strengthened by commercial problems stemming from the mass of unemployed and those who "came back home", as a result of industrial decline and general poverty.

Table 1

**The values of gross domestic product<sup>7</sup>**

SPECIFICATION	In mln euro			Per capita, in euro		
	2007	2008	2009	2007	2008	2009
Podkarpackie ( Poland )	11582	13777	11712	5500	6600	5600
Northwestern District (including Bihor, Maramures, Satu Mare and Selazh - Romania)	15 203	15905	13637	5600	5800	5000
District Centre (Romania)	14811	15565	13450	5900	6200	5300
Northeast District (including Botosani and Suceava - Romania)	13779	14927	12810	3700	4000	3400
Prešov Region (Slovakia)	4472	5624	5359	5600	7000	6700
Kosice Region ( Slovakia)	6460	7609	7007	8400	9800	9000
Chernivtsi Oblast (Ukraine)	965	1146	781	1065	1268	863
Ivano-Frankivsk Oblast (Ukraine)	2012	2320	1586	1454	1679	1149
Lviv region (Ukraine)	4046	4610	3308	1578	1804	1297
Transcarpathian Oblast (Ukraine)	1519	1714	1154	1222	1379	928
Northern Hungary (including Borsod-Abaúj-Zemplén and Hevesh)	7857	8077	6778	6300	6600	5600
Northern Great Plain (including Hajdu-Bihar, Yas Nadkun-Szolnok, Szabolcs- Szatmár-Bereg - Hungary)	9449	9981	8862	6200	6600	5900

Effect of society destruction by unemployment – as research studies, conducted in the Carpathian Euroregion showed – has become blunt by social agriculture, which mentally predominated on the territory of the Carpathian Euroregion in the 1990s (and generally in rural areas of the participating countries). This phenomenon did not have any significant economic reflection but its social impact was significant (although this is not the appropriate measure assessed even by region sociologists).

The existence of private agriculture in the Carpathian Euroregion is non-budget for residents of rural regions, and - in the absence of any other alternative forms of accommodation - a matter of life and death.

Due to the physical geographical conditions of Euroregion, a share of agricultural areas in these five countries - at the expense of the mountains in the region - is less than the share of the other country's territory. Only Hungary is an exception, because its degree of lowlands is relatively high. But in contrast, of course, the ratio of forests and grassland is much higher on the whole territory of the Carpathian Euroregion, than anywhere else.

Overall, 62.2% of all the five countries and 53.9% of the Carpathian Euroregion are agricultural areas. The highest level of agricultural land among these five countries is in Hungary (65.8%), but it exceeds the national rate even if it is compared with the level in regions belonging to the Carpathian Euroregion (68.5%). Ukraine takes the second position according to the level of agricultural areas (63.9%). However, similar to its territory that belongs to the Carpathian Euroregion - through the mountainous terrain here - differs very much (50.6%). The next one is Romania (62.3%) where this level is also much less within the Carpathian Euroregion (55.7%). National average level of Poland is 59.7%, while, as in the regions belonging to the Carpathian Euroregion, it is only 55.2%. The lowest level is in Slovakia, as the result of the mountainous terrain, the area of agricultural terrain is small at the national level (49.9%), as well as in the eastern Slovakia regions (i.e., the total value of Kosice and Prysashevskiy region), which doesn't even approximate this (45.4%).

Table 2

**Average monthly gross wages<sup>7</sup>**

Region (country)	in euro
Podkarpackie ( Poland )	689
Northwestern District (including Bihor, Maramures, Satu Mare and Selazh - Romania)	377
District Centre (Romania)	401
Northeast District (including Botosani and Suceava - Romania)	386
Prešov Region (Slovakia)	733
Kosice Region ( Slovakia)	168
Chernivtsi Oblast (Ukraine)	183
Ivano-Frankivsk Oblast (Ukraine)	184
Lviv region (Ukraine)	175
Transcarpathian Oblast (Ukraine)	616
Northern Hungary (including Borsod-Abaúj-Zemplén and Hevesh)	583

Euroregion is also characterized by a low level of tilled land, which is also a consequence of the relief conditions. The Carpathian Euroregion comprises 12.

8% of the territory of these five countries, but its share on tilled land is only 9.4%. The level of fields (meadows, pastures) is higher in all member states of the Carpathian Euroregion than in other parts of the country. Even in this case, in some countries (Hungary, Ukraine and Slovakia) number of gardens, fruit trees and vineyards is also higher. The ratio of labor force to the size of tilled lands is shifted into the side of the labor force in equalizing to the average in all countries except Hungary. This is even more visible if we take into account the quality of tilled lands, but in this case Hungary is not an exception, as well as in the ratio of tilled lands per rural population.

This contrast is especially seen between the size of tilled lands (9.4%) and rural population (18.3%). Consequently, the number of rural population is twice bigger. This means that in the Carpathian Euroregion there is a relatively large overpopulation. Of course, the amount in various countries differentiates: the most significant contrast is observed in Ukraine (the tilled lands: 8%; the rural population: 22.9%), but in Poland, the difference is also significant (6.6% and 13.1% ). Thus, one of the biggest problems across the region is the agrarian overpopulation, and as a consequence, the level of agricultural production in comparison with other parts of the country, the production value in one hectare of agricultural land is far behind the national indicator. Therefore, the part of Euroregion territory in the national agricultural production is significantly lower than its share in the rural areas. The intensity of agricultural production is significantly lower than the national average, because the territory that belongs to the European region can be estimated as less developed, not only from the perspective of industry, but also from the perspective of agriculture.

The agrarian culture, traditions and the knowledge of the farmers who live in the territories of Ukrainian regions, which belong to the European region (formerly Western Ukraine), and especially their relationship (motivation) to the land is more favorable than the Ukrainian average indication. This actually explains the fact that these areas during Stalin's "reprivatization" belonged to Poland and Austria-Hungary and thus landowners were able to avoid the elimination during 1928-1933. Providing the labor force in the agriculture is the best in the Transcarpathian region, among Ukrainian regions members of the Euroregion. In western Ukraine farmers have high levels of productivity in relation to hectare, with the maximum value of invested workforce but despite this, the productivity is the lowest here than in the entire Ukraine. This shows that reaching a certain limit, the lack of land and severer environmental conditions cannot be compensated by excessive labor force. In the Transcarpathian region, where the value of production of fruit, vegetable and vine growing is the largest in Ukraine, the value of production per one farm worker is the lowest one. The main reasons for this are small share of the land per the farmer and the lack of capital (loans).

Nowadays, the transformation of the economies of the Carpathian Euroregion happens in the conditions, accompanied by the deep regional crisis.

The «lag» of the region from the main regions of their country is an integral feature of the regional crisis. In the Carpathian Euroregion, the economic changes are accompanied by significant unemployment in the region because you can barely find several settlements in each country where the unemployment rate reached the double level of the national indicator.

Even today unemployment in many countries exceeds 30% in the Carpathian Euroregion. Of course, part of unemployment has got a structured nature. Therefore, differences appear between the qualification of labor force and demand of new work places. At the same time, there is a great concern that the unskilled unemployed with low cultural level (which is rather large number of unemployed) will be driven out of the labor market and forever find themselves on the social periphery. According to the regional average number, there is another hidden picture about unemployment, but unemployment in no case does not mean the same problem everywhere.

We believe that we need to intensify the production structure for the development of rural areas in the Carpathian Euroregion. In addition, it would be also important for a rural population to get access to full distribution of profits derived from agriculture.

Unfavorable political processes and relations can create serious obstacles for economic development. However, now we are in such specific and unique situation, when relations can dramatically change between border regions and their collaboration can rely only on different and new basis.

Today there appeared a possibility for active collaboration of peripheral regions and for the new form of collaboration, development of international regional integration. The basis for this interregional collaboration is provided by the political and economic transformation processes in the early 1990s. The change of the regime and more close relations with Western Europe generated a hope in cross-border collaboration in our region as well, thus, created possibilities for adaptation of West-European experiences.

Despite the existing factors of limiting character, we consider that activity of the Carpathian Euroregion must play an important progressive role for member regions, and also show an important aid in solving the problems of national minorities (first of all, problems of education and health protection of national minorities). Of course, the "survival" of the Carpathian Euroregion largely depends on how effectively this interregional association uses and attracts available resources (natural, economic and - foremost human capitals) and how it can combine various interests in cooperation.

**3. Principles of sustainable development.** The Carpathian Euroregion has all economic, social and environmental problems peculiar for world civilization in general. The greatest pressure on nature and environment in the region is created by:

- industrial and agricultural productions, first of all powers, that produce chemically active, poisonous and radioactive wastes (chemical industry plants, integrated wood and chemicals mill, shops and areas of galvanic production, integrated asphalt and bitumen plants etc.);
- motor transport and railroad industry;
- mining industry (mines, careers etc.);
- main oil-, gas- pipelines;
- powerful sources of the electromagnetic fields (radiolocation stations, high-voltage lines etc.);
- cargo-handling works and migratory processes connected with the frontier collaboration;
- scientifically groundless deforestation, that is accompanied by a number of problems (erosion, destruction of fertile layer of soil, reduction of powers of waterway, appearance of wind-fallen trees, floods, landslips, mudslides, etc.).

These and a range of other negative phenomena and tendencies are, undoubtedly, the consequence of hasty socio-economic politics of the government in previous years. The estimation of ecological situation shows that substantial anthropogenic transformation of landscapes and considerable pollution of environment is peculiar for the greater part of the Carpathian Euroregion. Unlike other regions of participating countries, distribution of pollution does not have general nature here.

The deficit of powerful sources of water supply stipulated absence in the Carpathian Euroregion of large hydrogenous industries. It is mainly connected with low index of water pollution on its territory in comparison with Europe. The state of water supply of settlements of Carpathians with every year gets worse as a result of predominance of the extensive increase of volumes of water-supply, at inefficient organizationally - economic and backward technical supply of hydrogenous activity.

A special concern is caused by high pollution of soils of region by mineral fertilizers and pesticides, that is largely assisted by branch specialization of its agriculture industry in the production of vegetables and industrial crops, and especially - some early sorts of vegetables and fruit (early sorts of cabbage, tomatoes, peppers, strawberries, etc. - especially Ukraine and Hungary).

Barbarian attitude toward basic natural wealth - forests inflicts great damage to the environment of the Carpathian region. In the last two centuries scientifically unfounded deforestation has led to a decrease in their areas, violated age structure, reduced natural growth of wood, inflicted damage to hydrogenous system, have become the reason of frequent natural disasters (floods, landslides, mudslides, washing off of fat land, storms etc.) In 1947-1957 more than 70 million cubic meters of wood were stored in the Carpathians, as a result of which 20% of the area was deforested. This situation repeated at the turn of the century. A lot of landslides, increasing number of floods in



mountainous rivers, changing climate were activated due to deforestation of slopes. Afforestation of cleared space with a monoculture fir tree leads to frequent storms.

For the last decades in the Carpathian region and particularly in the Transcarpathian region the cases of ecocatastrophes have become more frequent. Continuous deforestation in the last century, reduction of the upper limit of the forest, the replacement of natural beech stands by artificial fir, degradation of lowland floodplain complexes and other negative factors have led to the loss of functional core of natural landscapes complex "mount - lowland". Water adjustment, soil protection and climate formation functions of the forest are deeply affected. This is confirmed by such phenomena as the devastating floods, landslides, mudflows, and as a result - soil erosion and loss of water resources. Thus, for example, at the modern state of many forest massifs of the Carpathians the average annual washing off of soil from mountain slopes is 0,5 cm., as a result the 4,5 million tons of silt and nutritive are dart out by the rivers outside an area, as degraded streamside ecosystems of lowland and available dams do not allow to lock the cycle of rotation of substance and energy within the territory. It is especially important for Ukrainian part of the European region, where tilled lands, in particular lowlands comprise 75%, and cost price of separate types of agricultural products is several times higher, than in other regions of Ukraine.

A loss of water resources is especially fast. In particular, since the end of 1960s - early 1990s the level of groundwater in the Transcarpathian Lowland has lowered for about 2 m, and since middle of 1980s there has been tendency in the increase of average annual temperature of air and increase of amount of total atmospheric precipitations that is to some extent a consequence of global warming. Therefore, renewal in the vegetable cover of all vegetable zones of region is especially important now.

Only in the Ukrainian part of the European region of Carpathians from the end of XIX to the middle of 90th of XX of century catastrophic floods took place 21 times, 16-mudstone streams, 25 - avalanche and 12-storms, that inflicted losses to the national economy in the billions UAH. Such destructive floods, as in the last decade the Carpathian region did not know ever. Losses from floods in the region of the Carpathians in the last decades are annually estimated by a sum almost in a 15 million UAH, and in 1998, 2001 and 2011 they were 500, 300 and 600 million UAH, accordingly. The worst thing is that the intensity of floods and their frequency of occurrence, collapsed and filled with water site, large-scale destruction that they bring and amount of human victims grows from year to year.

For the European region of the Carpathians a problem of mountain districts is especially sharp, which should have a special status that would legally approved essential benefits and social guarantees for their residents. Due to this a very important Act was adopted by the Parliament of Ukraine "On

status of mountain settlements of Ukraine" (Law of Ukraine № 56/95 from 15.02.1995) and acceptance of the Government program of socio-economic development of region of Carpathians, worked out by institute of regional researches of Ukraine together with Ministry of economy of Ukraine and executive structures of regional councils of the Transcarpathian region, Ivano-Frankivsk, Lviv and Chernivtsi regions.

For many centuries civilized Europe has been building dams, coastal reinforcements, reservoirs that regulate flow and other hydrotechnic protective constructions on the rivers for the aim of protection from winter melted and large autumn rain waters. It was enough to protect themselves entirely from big water. These technical constructions have kept people safe till the last decades. It all changed abruptly at the beginning of the XXI century, when spring floods and freshets began to appear quite often and in an unpredictable manner, and the big water started to come out of man's control and destroy all technically - technological property of humanity with a great power.

It must be admitted, that meteorological conditions were really unfavorable for Europe both in autumn of 2010 and in the early 2011. Summer rains and winter warming enhanced abrupt accumulation of large quantities of water in the Carpathians and the Alps, which quickly overfilled channels of many rivers and flooded the European valleys. But, being the cause of flood, overwhelming quantity of water couldn't be the main reason of those catastrophic results and huge damages, which doomed Europe and, provinces of the Carpathian region in particular during the last years.

Due to conclusions of many scientists and specialists, who investigate these phenomena, the basic cause of recent catastrophic floods should be sought not only in the change of natural conditions, but in a great technogenic pressure on the nature, caused by the humanity in the last years. This man-made pressure is a cause for all natural disasters, including the change of natural conditions and constantly growing quantity and intensity of spring floods and freshets.

Lion's share of problems in relationships between society and nature is stipulated by absence of ecological culture and ecological consciousness on the personal values level. Ecological culture is a measure of moral maturity of human, the measure of one's right mind in many acts. In addition to this it should be clearly stated, that disastrous processes as in the nature, so in the society create the conditions for neurosis, general psychosis, provoke aggressive and destructive behavior.

Thus it should be stated that within the Carpathian Euroregion rates of degradation of scope of life exceed greatly the rates of realization by the population and authority this extremely dangerous process. Gradually, the Carpathian Euroregion transferred to the ecologically-averaged and technogenically-contaminated region.

Nowadays European community and political governments, that rule on behalf of it, admit exclusive role of mountainous regions as a source of natural resources, biological variety and its powerful recreational potential, that provides keeping world climate balance on the planet. Therefore, practically half of the European population depends of changes in ecological situation in mountainous regions. They also admit the poor economic development of the mountain region in comparison with the flat territories due to their, as a rule, peripheral location and difficult natural conditions. Mountainous regions very often are multicultural space, where the representatives of many nationalities live together, affected both their local periphery as well as difficult climate conditions. Mountain ecosystems are especially sensitive to the technogenic influence, and results of changes occurred in generating problems of economic, social, ecological and other character, separately from international borders, and are achieving nationwide and international scale.

So it becomes clear for everyone that urgent measures should be taken at all managerial levels, from local to supranational, for the purpose of their socio-economic raise and providing ecological balance. Specific role in promoting the policy of sustainable growth should be held by local and regional authorities, that should demonstrate real leadership in elaborating territorial planning programs, encourage cross-border and interregional cooperation, acceleration of socio - economic development and increase of competitiveness of mountainous regions.

The board of interregional structure of the Carpathian Euroregion recognizes that in the development of mountainous areas particular attention should be given to the introduction of principles for sustainable development and transparent, public and adequate management.

Bearing in mind unique contribution of mountain regions in the maintenance of the global climate balance, the matters of natural cataclysms prevention and ensuring acceptable living conditions on Earth are enhanced by the Declaration on Environment and Development ("Agenda for the 21st Century", Rio de Janeiro, 1992), Declaration on Environment and Sustainable Development in the Carpathian and Danube Region (Bucharest, 2001), the Action Plan of the World Summit on Sustainable Development (Johannesburg, 2002) and many other international documents, scientific studies and reports, which note that:

- the Carpathian mountain regions comprise unique natural, socioeconomic and ethno-cultural legacy of humanity, they are an indispensable source of natural resources, water and air regeneration and one of the key climate formation factors on Earth;

- the Carpathian Euroregion being one of the largest European mountain ranges, with population of about 20 million people and having a third part of European flora, plays a special social and economic role and significantly affects the formation of climate and water balance in Europe.

As it is stated in the "Declaration of Uzhhorod" which was accepted at the International Conference "Sustainable Development of the Carpathians and other mountain regions of Europe", in Uzhhorod, September 8-10, 2010, for the implementation of sustainable environmental and economic development at the level of the Carpathian region, such measures should be taken:

*a) in socioeconomic sphere:*

- transforming the mountainous regions including the Carpathian region into cultural, tourist and recreational centers by preserving original cultural legacy areas and the creation of modern infrastructure for recreation and health of people and the conditions for the cultivation and production of ecologically clean agricultural products;

- restructuring of ecologically dangerous industries especially logging and mining, taking into account the ecological state of the territory through the introduction of modern ecologically safe technologies, and reorientation to ecological preservation activities of society;

- providing fair, efficient and sustainable water resources management, upgrading services in water supply and sanitation, protection of water resources from pollution;

- enhancing social protection of mountain regions and intensifying measures of social and transport infrastructure development;

- promoting socio-economic development of mountain regions by stimulating investment, entrepreneurship and farming;

- encouraging the application of clean energy sources in mountainous areas, including hydroelectric and wind power stations.

*b) in ecological sphere:*

- accomplishing of national ecological networks of protected areas as components of European Ecological Network;

- organizing long-term environmental monitoring of mountain regions;

- developing and implementing technologies and programs for mountain river basins and forest areas, early warning and consequences elimination of natural and man-made disasters in mountain areas together with relevant institutions of the Council of Europe and EU;

- creation of unified database of environmental information on the basis of which to develop annual maps of ecological situation changes and computerized system of ecological protection areas for the Carpathian and other mountain areas;

- taking measures in increasing of forest planting areas, improving of water regulation function and prevention of unlawful deforestation;

- program implementation on fertility improving and erosion preventing on mountainous lands;

- creation of effective waste collection, utilization and tertiary treatment systems, support of local and regional authorities, territorial communities, nongovernmental organizations initiatives in intensifying of chemical, biological and domestic waste utilization, development of scientific investigations oriented on the study of ecologically safe areas for waste disposal and decrease of environmental pollution, renewal of broken ecological systems;

*c) in social and political sphere*

- support initiatives of nongovernmental organizations for environmental protection;

- provide the possibilities for mountainous population to take part in the process of making decision on territory planning, natural resources usage, etc.;

- increase legal responsibility of organizations and citizens for environment pollution;

- conduct systematic informational and educational work on the formation of ecological culture of people.

**4. Conclusions.** In implementing the ideas of sustainable ecological and economic development of the Carpathian Euroregion it must be considered that civilized peoples should protect and increase well, approve high spiritual values of human lives in the society and social consciousness with the help of laws and rules. Taking into account natural, economic and intellectual resources of the Carpathian Euroregion, the strategic goal lies in the creation of effective ecologic and economic system, which can provide rising development and ecologic safety for the Carpathian Euroregion. In this context Concept, Programs and Plans on development of state members regions of the Carpathian Euroregion for a close and continuous perspective are very important. Only education, intellect and ecologic culture can provide the basis for sustainable ecologic and economic development of separate regions, countries and world community in general.

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# EFFICIENCY EVALUATION OF INVESTMENT PROJECT

## POSÚDENIE EFEKTÍVNOSTI INVESTIČNÉHO PROJEKTU

*Roman LACKO - Zuzana HAJDUOVÁ – Marek ANDREJKOVIČ*

### **Abstract**

The aim of this article is to evaluate successful of investment project in company dealing with mining, processing and selling of a sand after completion the investment phase. Based on consulted theoretical foundation points it out on practical basics of project. Subsequently it is focused on evaluation of quality in processed project and evaluation of success pre – investment and investment project phase. Research have been evaluated as successful and confirms accuracy of assumptions in plan preparation of investment project.

### **Keywords:**

investment project, company, plan

### **Abstrakt**

Článok sa zaoberá hodnotením úspešnosti investičného projektu spoločnosti zaoberajúcej sa ťažbou, spracovaním a predajom štrkov a piesku po ukončení investičnej fázy. Po nahliadnutí na základné teoretické východiská, poukazuje na praktické východiská projektu. Následne sa zameriava na hodnotenie kvality vypracovaného plánu a hodnotenie úspešnosť predinvestičnej a investičnej fázy projektu. Vykonaný výskum hodnotí projekt do tejto doby ako úspešný a potvrdzuje správnosť predpokladov pri tvorbe plánu investičného projektu.

### **Kľúčové slová:**

investičný projekt, spoločnosť, plán

## **Introduction**

Many innovations is conditional by investing to long – term property. Every investment is needed to reevaluate in advance. There exist many method of evaluating efficiency of investment project and is up to company which will be used depending on character of investment. In preconditioning phase , each attributes of project are only estimated. After the project implementation, it is possible to evaluating accuracy of estimations in preconditioning phase. Many companies does not focused on project realization in preconditioning phase sufficiently, therefore it can become that investment is not profitable and the company can get into financial problems.

## **Background and related works**

According to Vlachynsky [1] made decision on long-term capital allocation is an important area in company financial management . Middle management is responsible for identifying problems, finding solutions and potencional opportunities. Consequently, top management made decision on the

acceptance of the projects. Among the most important criteria for making decision on selection of project include profitability, risk and liquidity. To evaluation of effectiveness of investment project are most commonly used net present value, internal rate of return, return of investments and index of present value. Making decisions on capital structure sometimes depend on the choice of project and vice versa.

The main phases of investment project are shown in the following figure :



Figure 1  
**Phases of investment project**  
 Source: Fotr, Souček [2]

Each of these phases has own purpose and requires proper attention. After completion of various phases is appropriate to revise how successful the phase was. If we want to evaluate these phases we need to determinate criteria. This process is solely the responsibility of managers. According to Janekova, usability of certain method is conditional by type of evaluated investment, period of economic life investment, monitored targets resp. targets in investment and phase of company life cycle in which is realized an investment.

This article is focused on evaluation of preinvestment and investment project phase.

### **Pre-investemt phase of the project**

Scholleová [4] is divided pre-investment phase into three sections:

- clarification of investment opportunities
- preliminary technical and economic study
- performing technical and economic study

Clarification of investment opportunities is a neccesery foundation for entire investment project. Gathering suggestions for business opportunity means still evaluating and monitoring environmental factors, which may include demand, export, new products, technology etc. A preliminary technical and economic study is opposed to performing phase less similar. Basically, we should avoid



high cost associated with the analysis in case of situation in which the project was evaluated as unacceptable.[5]

### **Investment phase of project**

Investment phase can be characterized as a set and sequence of actions following in a row, forming own role in realization investment project. The key to success in this phase is to draw up the plan in highest quality in preinvestment phase of project and quality in managing during preinvestment phase.

Performance of managing the project can be used several methods, which can include critical path method, PERT method, Gantt chart ,etc. Deviation in real project implementation from the planned project means a new conditions for project that they are desirable to be reflected into changes in evaluating the economic efficiency of project. Opposed to pre-investment phase in which quality and data relevance are crucial measure, in investment phase is crucial time a measure. If a company is trying to reduce costs in pre-investment phase, this can lead to problems in investment phase. [5]

### **Material and methods**

We studied efficiency of investment project , which was entered by company dealing with mining, processing and selling of gravel. In cooperation with top management he suggested the plan and evaluated validity of investment project by using a selected methods.[6]

In 2012 the company had a problems to meet demand to sand and gravel of its main customers while the production was operating in 16 hours a day, 7 days a week the whole season. These problems persisted in 2013.

In 2014 company signed supplier – customers contracts , which undertook to deliver double the amount of sand and gravel to their customers. Therefore company management thought about investing in innovation of production line which would increase capacity up to 180 tons/hour. The aim of the investment project had to change a major three parts of the line. First step was replaced a dehydrator. After replacing dehydrator, conveyor was replaced too.

An important part was replacement of shower slid, which lead from sorter to conveyor belt of individual fractions. The company set an optimal values for four selected indicators to evaluation of economic efficiency of project. The first of these, net present value, which express the difference between the sum of discounted cash flow and capital expenditure, second indicator was rate of return, third indicator was internal rate of return and last one was index of profitability. Required values are shown in the following sections, when are

compared with modified values of real expenditure after innovating production line.

Beside the following indicators it was drawn up a plan for work innovation of the production line which it is presented by Gantt chart, it is clearly shows each actions, their continuity and duration.

Process of work was planned and it is shown in following chart :

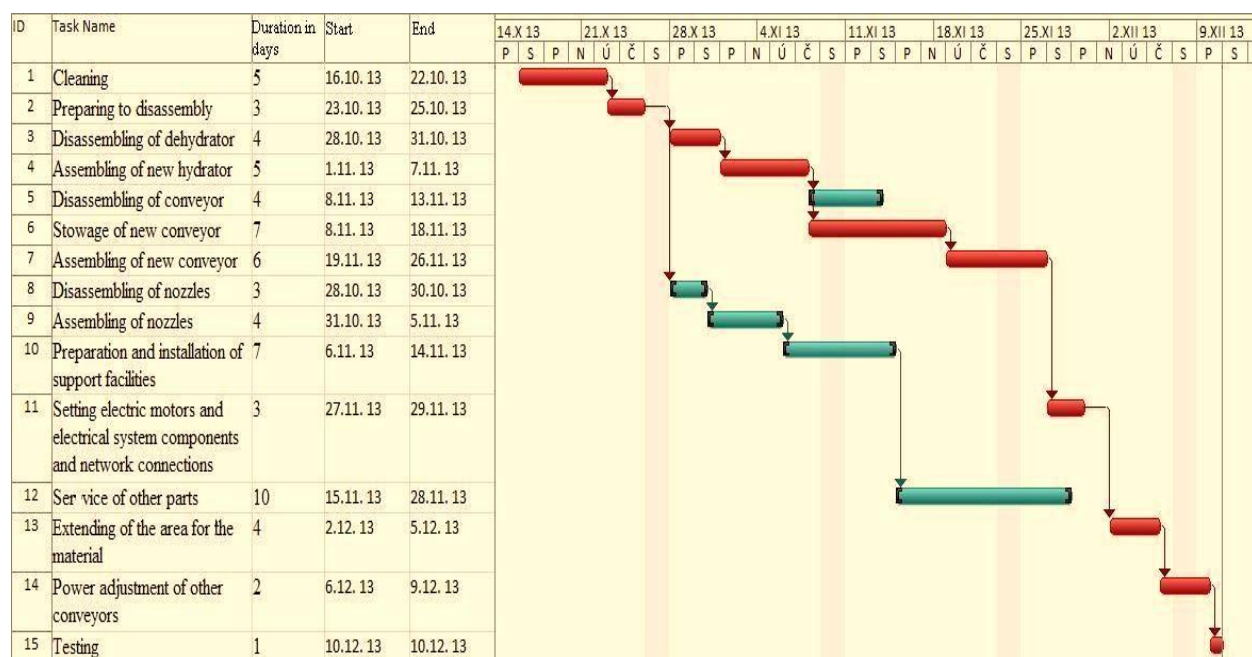


Figure 2

### Gantt chart

Source: own processing

The critical path is shown in red. Implementation of this project had been taken for 68 days and consisted of 15 phases. Implementation would be started in 16.10.2013 and completed in 10.12.2013. Period was chosen on purpose because the production line did not working. Using PERT method was anticipated that innovation had taken for 74 days.

## Empirical results

Company provided information about work process and expenditure related to innovation of production of the production line. In the following Gantt chart is shown real progress of the work.

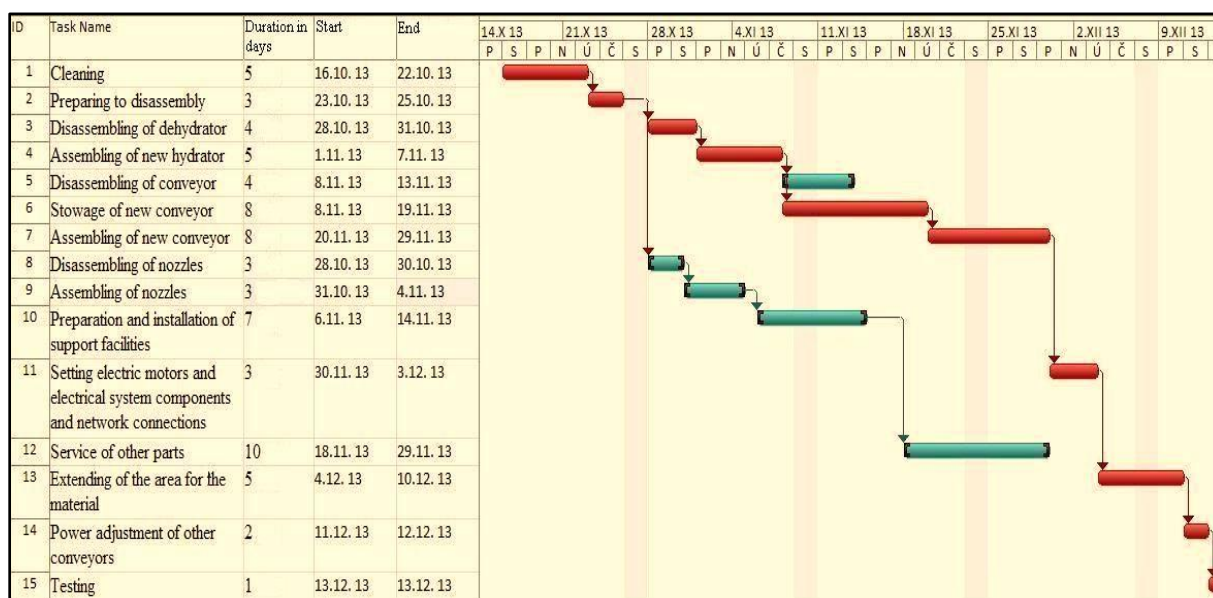


Figure 3  
Gantt chart  
Source: own processing

The first four actions have been realized by planned schedule. Problems encountered in disassembly old conveyor and installing a new, in this case, works have been extended in 3 day. To perform an operation no. 9 assembling of nozzles was needed three days insted of originally planned 4 days, but the critical path was not influenced by this, because it was performed simultaneously. The operation no. 13 was required to work one day longer, but this is also not to cause extension of time intended to line innovation. To innovate production line remained 71 days.

In work [6] suggested a preliminary plan of capital expenditure for project. Since it has been completed investment phase, we were able to gain data of real cost. Revenues still stay for our needs, they were not changed and we can consider those that were planned. The following table shows planned and actual condition of the capital expenditure, of which the value will be needed for the conversion of selected indicators of economic efficiency of project.

Table 1

Item	Planned expenditures	Real expenditures
Dehydrator DKP 110	61 470 €	62 364 €
Conveyor PD 650 x 27 000	33 600 €	33 439 €
OK nozzles	8 640 €	8 638 €
External work	18 700 €	19 100 €
<b>Total</b>	<b>122 410 €</b>	<b>123 541 €</b>

Source: own processing

Real expenditure was greater than planned about 0,924%. This increase was caused by increasing price of dehydrator about 1,9% and increasing price of external work, which was raised by time extension needed for innovation. Based on these data we draw up the cash flow plan, shown in the following table.

Increase of capital expenditure is reflected into depreciation as an expense, so based on changes in values, we calculated modified value of cash flow after completing second phase of project.

Table 2

<b>CF planned</b>	<b>37998,4</b>	<b>39725,9</b>	<b>41453,4</b>	<b>43180,9</b>	<b>44908,4</b>	<b>46636,0</b>
	<b>0</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>0</b>
<b>CF actual</b>	38031,7	39759,2	41486,8	43214,3	44941,8	46669,3
<b>after 2.</b>	7	9	1	3	5	7
<b>phase</b>						
<b>Relative</b>	0,088%	0,084%	0,080%	0,077%	0,074%	0,072%
<b>change</b>						

Source: own processing

Changes in cash flow are almost negligible.

Evaluation of effectiveness of investment project regarding to completing second phase, we compare indicators calculated by planned capital and real expenditure. Calculation of rate of return indicator regarding to time factor, we need to know cumulated and discounted cash receipts and of course the value of capital expenditure.

The return of invested capital will be reached between 3 and 4 year, what we have deduced from cumulated cash flow. After gaining information we calculated the values as follows :

$$3 \text{ year} + \frac{123\,541 - 98\,602,9}{29\,515,97} = 3,84 \text{ year}$$

Value of indicator net present value is following :

$$NPV = 182\,367,86 - 123\,541 = 58\,826,86 \text{ €}$$

Similarly, we choose method [6] to calculate the value of internal rate of return. The value of IRR is following :

$$IRR = 0,24 + \frac{1193,76}{1193,76 - (-1,767,17121)} (0,25 - 0,24) = 0,244$$

The last indicator is index of profitability, which is ratio of sum of discounted CF and capital expenditure. Modified values is following :

$$PI = \frac{182\,367,67}{123\,541} = 1,48.$$

## Conclusion

After modification of each indicators and Gantt chart, we have found the following facts. The real duration of realization the project was 71 days, which is three days more than it had been predicted according to Gantt chart, but three days less than had been predicted by PERT method. Relevance of the plane in this area is considered at high level of quality. The values of each indicators of economic efficiency and percentage modification predicted and real values are reflected in the following table :

Table 3

Chosen indicator	Required value	Predicted value	Real value	Percentage modification
Rate of return	Up to 3 years	3,81	3,84	-0,787%
Net present value	positive	59 797,67 €	58826,86 €	-1,623%
Internal rate of return	Higher than discount rate	24,75%	24,40%	-1,414%
Index of profitability	Higher than 1	1,489	1,48	-0,604%

Source: own processing according[6]

We can conclude that deviation of each indicators is negligible, its impact on the project is minimal and therefore, we can evaluate project after first two phases as successful. Plan of project was drawn up very precisely, what would be ultimately cost saving because it is not necessary to spend cost for dissension according to plan.

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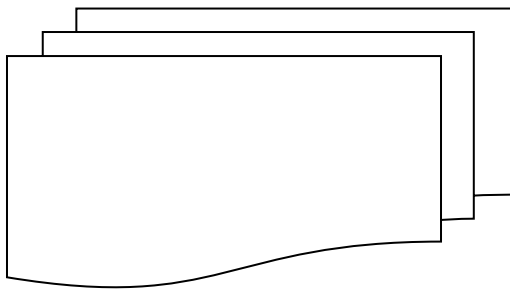


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