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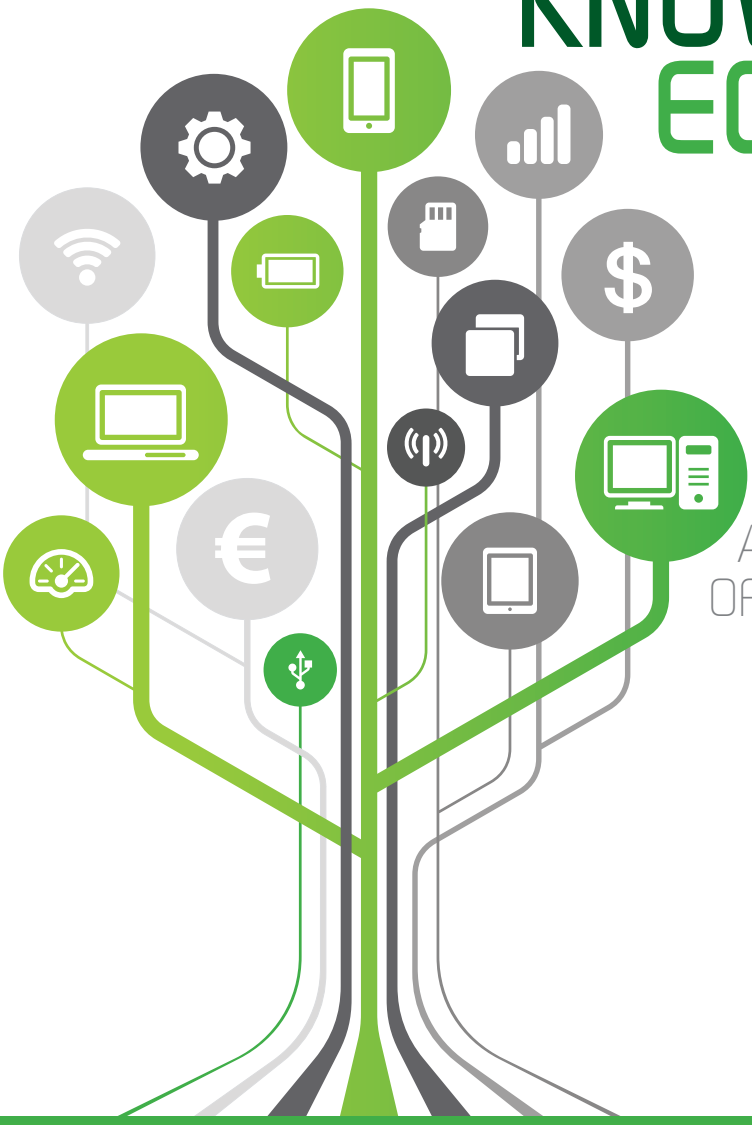

CHALLENGES AND DEVELOPMENT OF MODERN FINANCE AND INFORMATION TECHNOLOGY IN CHANGING MARKET CONDITIONS

Edited by
Anna Malina, Ryszard Węgrzyn

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Reviewer

Tomasz Wiśniewski

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Introduction

The dynamic development of finance is to a great extent related to the development of financial markets and one of the basic categories in finance – risk. Risk is an inseparable element of any economic activity and human life. Particularly in recent years, when we can observe the growth of risk connected with turbulences on financial markets, also the role of risk management is increasing. The significance of the measurement and modelling of risk, as well as its interdisciplinary character are also proven by the development of the tools of mathematics, statistics and econometrics within that scope.

A historical breakthrough in which a considerable increase in financial risk and market risk in particular took place, was the withdrawal from the international monetary system from Bretton Woods, which brought about notable growth of the fluctuations of exchange rates, interest rates and share prices. The changes became the stimulus to the development of the market for derivatives, including options, which enabled to secure against this type of risk. In recent years, due to the global financial crisis initiated as early as in 2007, the next substantial increases in risk have occurred. The undergoing processes of the liberalisation of business activity, deregulation of markets and the development of modern technologies are contributing to the progressing globalisation of the world economy and the integration of capital markets. Potential benefits and threats arising from these processes are new challenges for individual enterprises, markets and economies. Taking into consideration limited possibilities to decrease risk through portfolio diversification (due to high level of price correlation), the application of derivatives becomes necessary, particularly in the periods of market turbulences. Rapid development of research in this respect could be observed in the world literature as early as in the 1970s. Significant development took also place in the following decades with the development of the technique of data collecting and processing and possibilities to make complex computer calculations.

In the era of the increased level of risk, the interest in the risk management concepts is rising not only among theoreticians but also among practicians. For business entities the key element is to identify the sources of risk and the capability of reducing its negative consequences. The awareness of the existence of possible threats is the condition of active risk management. An important aspect here is the systemic approach, considering also the relations with the entities of the market environment.

Over the last several years, the links among financial markets, particularly stock markets, of many countries have increased distinctly. They manifest, among others, in the growing capital flows and changes undergoing on the institutional level. The changing conditions of the functioning of financial markets bring about changes in investment preferences, as well as those related to raising capital. Analyses within that scope often require the engagement of very sophisticated quantitative methods which constitutes a serious challenge, especially to the practicians of financial markets.

The financial crisis mentioned before is to a great extent also the crisis of trust. In this context, what becomes a very important challenge to accounting, the whole systems of accounting information is to ensure reliability and credibility of financial statements. The challenges are related to so-called creative accounting, which, in addition, is differently understood in various countries, and disclosure of some information. Deliberating on those topics and putting pressure on corporate social responsibility and the principles of ethics are also important factors.

The economy of the early 21th century is commonly identified with the era of knowledge and innovative technologies. The processes of globalisation and social and economic integration are connected with the growing significance of non-material resources as the key determinants of the functioning and development of market entities. The development of the scope and the manner of using those

resources has exerted a substantial impact on the whole system of enterprise management, and with it on such areas as: finance, marketing, human resources and research and development. At the same time, it has become a premise to the development of the instruments used in individual areas, including ICT tools and quantitative methods. Fast development of information techniques and technologies, related, among others, to the popularisation of the Internet, has become an important factor stimulating the undergoing changes.

Information is a very important resource for every business entity. What becomes the basic challenge in this respect is the identification of changes in the functioning of information systems in various entities, as well as the search for effective solutions in the integration of information resources.

The signalled challenges and research problems are reflected in this work, the basis aim of which is to indicate optimal ways of management and analytical solutions ensuring the efficiency and effectiveness of the functioning of market entities. What results from the research problems so broadly planned is the many-sidedness of research issues focused on the following main thematic areas: risk management, investing on financial markets, accounting and information technology.

We are handing over to the Readers the monograph being the effect of research works of the academic staff members and doctoral students, in the area of broadly understood finance and information technology[1]. This monograph consists of four isolated parts presenting the problems of the following research areas:

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[1] This work inscribes into the series of publications under the common title *Knowledge-Economy-Society*, which constitute one of the effects of many years' cooperation between the academic environment of the Faculty of Management at the Cracow University of Economics and employees and doctoral students of other faculties of the University, with representatives of different Polish academic circles, as well as representatives of foreign academic circles. See: Oczkowska, R., & Mikuła, B. (Eds.). (2011). *Knowledge-Economy-Society. Challenges of the Contemporary World*. Cracow: Foundation of the Cracow University of Economics; Malina, A., Oczkowska, R., & Rojek, T. (Eds.). (2012). *Knowledge-Economy-Society. Dilemmas of the Contemporary Management*. Cracow: Foundation of the Cracow University of Economics; Lula, P., Mikuła, B., & Jaki, A. (Eds.). (2012). *Knowledge-Economy-Society. Transfer of Knowledge in the Contemporary Economy*. Cracow: Foundation of the Cracow University of Economics; Lula, P., Mikuła, B., & Jaki, A. (Eds.). (2013). *Knowledge-Economy-Society. Global and Regional Challenges of the 21st Century Economy*. Cracow: Foundation of the Cracow University of Economics; Malina, A., Oczkowska, R., & Rojek, T. (Eds.). (2013). *Knowledge-Economy-Society. Challenges of the Contemporary Management*. Cracow: Foundation of the Cracow University of Economics; Oczkowska, R., & Śmigielska, G. (Eds.). (2014). *Knowledge-Economy-Society. Dilemmas of the Economic Resources Management*. Cracow: Foundation of the Cracow University of Economics; Lula, P., & Rojek, T. (Eds.). (2014). *Knowledge-Economy-Society. Contemporary tools of Organizational Resources Management*. Cracow: Foundation of the Cracow University of Economics; Malina, A, Oczkowska, R., & Plichta, J. (Eds.). (2014). *Knowledge-Economy-Society. Contemporary Organizations in the Process of Institutional Transformations*. Cracow: Foundation of the Cracow University of Economics; Mikuła, B., & Jaki, A. (Eds.). (2014). *Knowledge-Economy-Society. Managing Organizations: Concepts and Their Applications*. Cracow: Foundation of the Cracow University of Economics; Oczkowska, R., & Śmigielska, G. (Eds.). (2014). *Knowledge-Economy-Society. Problems of Management and Financing Economic Activity*. Cracow: Foundation of the Cracow University of Economics; Malina, A., Oczkowska, R., & Kaczmarek, J. (Eds.). (2015). *Knowledge-Economy-Society. Challenges and Development Trends of Modern Economy, Finance and Information Technology*. Cracow: Foundation of the Cracow University of Economics; Borowiecki, R., Jaki, A., & Lula, P. (Eds.). (2015). *Knowledge-Economy-Society. Challenges of Contemporary Economies in the Face of Global Market Conditions*. Cracow: Foundation of the Cracow University of Economics; Mikuła, B, & Rojek, T. (Eds.). (2015). *Knowledge-Economy-Society. Reorientation of Paradigms and Concepts of Management in the Contemporary Economy*. Cracow: Foundation of the Cracow University of Economics; and Oczkowska, R., & Śmigielska, G. (Eds.). (2015). *Knowledge-Economy-Society. Challenges for Enterprises in Knowledge-Based Economy*. Cracow: Foundation of the Cracow University of Economics.

I. Contemporary issues and tools of financial risk management.
II. Conditions and factors in making effective decisions on the financial markets.
III. Challenges and development of modern accounting.
IV. Development of modern information and communication technologies to support decision making.

Part One comprises the risk management issues: the problems of the risk measurement – defining economic capital (*Stanisław Wanat*), forecasting bankruptcy risk (*Barbara Pawełek* and *Dorota Grochowina*), as well as reducing risk by means of options – the efficiency of delta hedging (*Ryszard Węgrzyn*), the application of static hedging (*Natalia Iwaszczuk*). In the context of risk management in the enterprise, specific conditionings of investments on the energy market are presented (*Marek Michalski*), as well as some important issues of the application of the systemic approach (*Jacek Pera*), and attention is paid to the risk of so-called bancassurance agreements (*Ryszard Pukała*).

Part Two mainly presents the issues related to investments on financial markets. With the use of advanced quantitative methods, investments in innovations are analysed and assessed (*Elena Rogova* and *Daria Guseva*), disposition effect is analysed (*Magdalena Piechowicz* and *Małgorzata Snarska*) and the links between the stock market and the diamond market are assessed (*Jakub Piłka* and *Małgorzata Snarska*). Attention is also paid to the problems of financing through issues on the financial market (*Dragan Stojković, Srđan Šapić* and *Jovana Golo*), the allocation of financial resources in the context of social conditionings (*Grażyna Plichta*), as well as the use of real options at investments in the information technologies sector (*Paweł Lustofin*).

Part Three of the monograph comprises accounting issues. This part tackles important problems of creative accounting (*Artur Hołda* and *Anna Staszel*) and disclosing bankruptcy costs by enterprises (*Kinga Bauer*), it presents the results of an interesting survey concerning changes in the accounting information systems (*Jan Madej* and *Katarzyna Szymczyk-Madej*) and the application of electronic communication forms (*Michał Baran*), attention is also paid to the dilemmas of the valuation of intangible assets (*Marek Mikosza*). The part ends with inspiring challenges of accounting, discussed in the context of corporate social responsibility (*Mirosława Kwiecień*) and ethics (*Lesya Ratushna*).

Part Four of the monograph discusses the problems of the application of specific ICT tools. It presents the use of textual analysis (*Paweł Wołoszyn, Katarzyna Wójcik* and *Łukasz Walewski*), an advanced cluster analysis (*Paweł Wołoszyn* and *Janusz Morajda*), as well as the issues of systemic solutions concerning the system integration (*Dariusz Put*), the measurement of the efficiency of IT processes (*Jan Ministr*), the interface modelling (*Jan Trąbka*). In the final part attention is paid to the ICT applications in supporting healthcare (*Ewa Soja*) and managing public utility entities (*Jagoda Komusińska*).

Anna Malina, Ryszard Węgrzyn

PART I

CONTEMPORARY ISSUES AND TOOLS OF FINANCIAL RISK MANAGEMENT

Chapter 1

Modelling Economic Capital Using Copulas[1]

Stanisław Wanat

1. Introduction

Financial institutions such as banks, insurance companies, as well as banking and insurance groups are exposed to many risks (e.g. market, credit, insurance and operational risk). To ensure protection against possible consequences of risk materialisation, they have to maintain a certain level of capital. Rating agencies, supervisors and debt holders want higher capital to support solvency while shareholders, striving to increase profitability, are interested in keeping it at a lower level. As a result of these conflicting interests, capital needs should be optimised. At present, financial institutions usually solve the problem of determining the optimum value of means ensuring security by estimating the so-called economic capital reflecting unexpected losses resulting from the actual risk exposure. It should be pointed out that in recent years, the concept of economic capital has evolved from risk and performance measurement to the determination of capital adequacy. At the moment, it is understood as an amount of capital necessary to secure, at an appropriate security level within a specified time horizon, the covering of potential losses being a result of materialisation of a broad spectrum of risks faced by a financial institution.

One of basic methods for calculating economic capital is based on a distribution of a random variable, modelling the aggregate risk of a financial institution. In this approach, the main challenge is a method for modelling dependences between aggregate risks. If the dependence structure is ignored, the economic capital is determined for a financial institution (for the aggregate risk) as a sum of economic capitals for individual risks. As a result, it is usually overestimated since it is unlikely that all worst-case scenarios materialise simultaneously. If risk independence is assumed, in turn, it causes that the economic capital is underestimated. In practical applications, a linear structure of dependences between risks is usually adopted, and the variance-covariance method is used for aggregation. However, such an assumption may lead to wrong estimates of the economic capital since in most cases, dependence structures are so complex that it is difficult to describe them with several numbers in the form of a correlation matrix.

[1] The study is supported with subsidies for maintaining research capacity granted to the Faculty of Management at Cracow University of Economics by the Polish Ministry of Science and Higher Education.

An alternative method for taking dependences into account in the aggregation process is the use of copulas. The main purpose of this article is to present possible applications of copulas in the process of estimating the economic capital and to show, using an empirical example, what possible consequences are of using the variance-covariance method, which is most popular in practice, if its basic assumption is not fulfilled (elliptical distribution of risks).

The paper includes a definition of economic capital, discusses issues related to its calculation, presents a copula as a tool for modelling dependence structures in the process of estimating the economic capital and discusses results of a simulation study. The study analyses the impact of selected dependence structures (modelled using selected copulas) on the economic capital and diversification effect for non-life premium and reserve risk of two business lines of an insurance company.

2. Economic capital

Economic capital is an amount of capital necessary to secure higher-than-expected potential capital requirements relating to all identified risks faced by a financial institution within a specified time horizon and at an assumed level of risk tolerance[2]. Therefore, it is a buffer that allows the institution to fulfil its obligations in the case of materialisation of an adverse scenario regarding considered risks. To estimate the economic capital, it is required to solve issues concerning:

- a time horizon (e.g. 1 year, *n* years, run-off of portfolio),
- the applied risk measure (e.g. *VaR*, *TVaR*, ruin probability),
- the risk profile of the financial institution (identification and classification of risks),
- methods of quantifying considered risks (e.g. stochastic models, stress tests),
- methods for aggregating capital requirements relating to the considered risks.

Solutions concerning the first four aspects are discussed, for example, in (Lelyveld, 2006). Below there are presented problems relating to aggregation.

As a preliminary remark, it should be noted that solutions concerning the five mentioned aspects of economic capital modelling are not autonomous in general, and a choice of solutions for one of them may limit the ability to choose solutions for others. Therefore, the discussion on the issue of aggregation is entered into with the assumption that losses resulting from materialisation of identified risk factors jeopardising a financial institution are modelled using random variables. In this case, the corresponding economic capital can be estimated, with the assumption of a given level of risk tolerance, based on the distribution of this variable and the adopted risk measure. It should be noted that the risk measure is not synonymous with the economic capital. It is a "tool" with which one can quantify a given type of risk and thus determine an appropriate amount of this capital. Under these assumptions, the economic capital for the *i*-th risk is determined as follows:

$$EC(X_i) = \kappa(X_i) - E(X_i), (i = 1, \ldots, k) \tag{1}$$

where:
$E(X_i)$ – expected value,
$\kappa(X_i)$ – value of the applied risk measure.

[2] This is not the only definition of economic capital. Different approaches to defining this term are considered, for example, in (Lelyveld, 2006).

In many financial institutions, the total economic capital is calculated in two steps:

- there are determined capitals for individual risks,
- there are aggregated capitals, obtaining.

In this approach, the second stage is of extreme importance since the aggregation of economic capitals for many risks that do not materialise at the same time causes that the total economic capital required to provide protection against these risks is lower than or equal to the sum of capitals needed for protection against each of the risks separately. It is known as the diversification effect (benefit), and it is a key element in the process of risk management of a financial institution. This effect is determined as follows:

$$d_f = 1 - \frac{EC(Y)}{\sum_{i=1}^{k} EC(X_i)} \tag{2}$$

where:

$EC(Y)$ − the total economic capital determined on the basis of a random variable:

$$Y = X_1 + \cdots + X_k \tag{3}$$

modelling losses arising from the aggregate risk of the financial institution. Thus, it is clear that the distribution of variable Y, which is determined by the structure of dependences between variables $X_1, \ldots, X_k$ is crucial for the calculation of the total economic capital $EC(Y)$, see. e.g. (Bellini, 2013; Bernard et al., 2014; Breuer et al., 2010; Carrillo-Menéndez & Suárez, 2012).

In practical applications, economic capitals are often aggregated with the use of the so-called variance-covariance method:

$$EC(Y) = \sqrt{\sum_{i,j} \rho_{ij} EC(X_i) \cdot EC(X_j)} \tag{4}$$

where:

ρ_{ij} – a linear correlation coefficient between variables X_i and X_j.

In the absence of correlation ($\rho_{ij} = 0$ for $i \neq j$ and $\rho_{ij} = 1$ for $i = j$), the formula (4) takes the form:

$$EC(Y) = \sqrt{\left(EC(X_1)\right)^2 + \cdots + \left(EC(X_k)\right)^2} \tag{5}$$

whereas when the variables are characterised by a perfect positive correlation $\left(\rho_{ij} = 1\right)$:

$$EC(Y) = EC(X_1) + \cdots + EC(X_k) \tag{6}$$

that is the total economic capital is the sum of economic capitals for individual risks. Obviously, the application of the formula (6) results in the absence of the diversification effect.

In the variance-covariance method, the dependence structure between variables $X_1, \ldots, X_k$ is modelled using correlation coefficients ρ_{ij} only. Therefore, from a methodological point of view, the properly estimated economic capital is obtained with the use of the formula (3) when variables $X_1, \ldots, X_k$ have a multivariate elliptic distribution. Because in many cases this assumption may

not be regarded as satisfactory, it is proposed in the academic environment to use a more flexible tool for modelling the dependence structure, which is a copula. In recent years, practitioners have used this tool more and more often.

3. Copula as a tool for modelling dependence structures in the process of estimating the economic capital

A copula C is non-decreasing and right-continuous mapping of a k-dimensional unit cube $[0,1]^k$ to the interval $[0,1]^k$, displaying all properties of a multivariate cumulative distribution function (*cdf*). Therefore, C is a k-dimensional distribution whose marginals $U_1,\ldots,U_k$ are uniform in the interval $[0,1]^k$ $\left(U_i \sim Uni(0,1),\ i=1,\ldots,k\right)$. The copula has been introduced in order to construct multivariate distributions on the basis of known one-dimensional distributions. The problem was first formulated and solved by Sklar (1959). In his theorem (called Sklar's theorem), he showed that with the use of copula C and one-dimensional *cdf*'s $F_1,\ldots,F_k$, it is possible to construct a multivariate cumulative distribution function as follows:

$$F(x_1,\ldots,x_k) = C\left(F_1(x_1),\ldots,F_k(x_k)\right) \tag{7}$$

and conversely, for any k-dimensional distribution function F with marginals $F_1,\ldots,F_k$, there exists a copula that meets the condition (6). This copula is unique for continuous distributions[3].

Thanks to Sklar's theorem, the copula is an important and useful tool to analyse multivariate distributions, which enables one to "link together" any one-dimensional distributions into a multivariate distribution (using the same copula) or to "link together" specified one-dimensional distributions using various copulas. The latter possibility is especially important in terms of modelling the distribution of the total loss (as defined by formula (3)) in the process of estimating the economic capital and diversification effect. In this case, we usually deal with a situation when we know, or we are able to estimate quite accurately, distributions of variables $F_1,\ldots,F_k$, but the main problem is to determine the dependence structure between them. A copula allows one to introduce such a dependence structure in a relatively simple way. Then the process of estimating the economic capital is as follows:

1. We determine distributions of variables $X_1,\ldots,X_k$.
2. Using a copula, we introduce the dependence structure between these variables. At this stage, we can identify such a structure by estimating an appropriate copula, or use different copulas corresponding to different scenarios. We apply the first approach when we are interested in estimating the economic capital; the other one is used to analyse the economic capital with the use of stress tests.
3. We construct a multivariate distribution (or different distributions) with the use of formula (7).
4. We simulate from this distribution a sample $\left(x_{i,1}^{(s)},\ldots,x_{i,k}^{(s)}\right)$, $i=1,\ldots,n$.
5. Based on this sample we estimate the empirical distribution of Y.
6. We determine the economic capital $EC^{(s)}(Y)$, using formula (1).
7. We repeat steps (4) – (6) S times to obtain S economic capitals $EC^{(s)}(Y)$.

[3] More information on copulas, their properties and possible applications can be found in the following works: (Frees & Valdez, 1998; Joe, 1997; Nelsen, 1999; Wanat, 2011a, 2012, 2014).

8. We set the economic capital $EC(Y)$ as average or median of capitals $EC^{(s)}(Y)$, $s = 1, \ldots, S$.

4. Impact of selected dependence structures on the economic capital – simulation results

The simulation study takes into account two risk factors and analyses the extent to which the dependences between them affect the economic capital and diversification effect. The non-life premium & reserve risk was analysed over a one-year time horizon for two lines of business of an insurance company: *motor vehicle liability* (LOB 1) and *other motor* (LOB 2). It was assumed that loss variables take the following form:

$$X_i = \frac{Z_i + R_{i,1}}{P_i + R_{i,0}}, \quad (i = \text{LOBl},\ \text{LOB2}), \tag{8}$$

where:
Z_i – claims paid in the year under review,
$R_{i,0}$ and $R_{i,1}$ – claims reserves at the beginning and the end of the year respectively.

With such a specification, the variable X_i reduced by 1 (i.e. $X_i - 1$) represents random losses attributable to an individual exposure to risk (unit of the portfolio) (cf. e.g. Hürlimann, 2008; Wanat, 2011b). According to the standard assumptions of Solvency II (cf. *QIS5...*, 2010), it was assumed that variables have a log-normal distribution with the expected value equal to 1 and the variance:

$$\sigma_i^2 = \frac{1}{(P_i + R_{i,0})^2}\left(\left(P_i\sigma_{i,p}\right)^2 + 2\rho_{pr}\sigma_{i,p}\sigma_{i,r}P_iR_{i,0} + \left(R_{i,0}\sigma_{i,r}\right)^2\right) \tag{9}$$

where:
$\sigma_{i,r}$ – standard deviation for reserve risk of the i-th line of business,
$\sigma_{i,p}$ – standard deviation for premium risk of the i-th line of business,
ρ_{pr} – linear correlation coefficient between the premium risk and reserve risk (in the technical specification of Solvency II, $\rho_{pr} = 0.5$ is suggested regardless of the business line).

In the analysis of the considered business lines, the same exposure to risk (the same size of portfolio) and values of necessary parameters, proposed in the technical specification of Solvency II (cf. *QIS5...*, 2010), were assumed (cf. Tab. 1).

Table 1. Parameters used in the simulation analysis

Motor vehicle liability (LOB 1)	**Other motor (LOB 2)**
$P_1 = 1.0;\ \sigma_{1,p} = 0.09$	$P_2 = 1.0;\ \sigma_{2,p} = 0.09$
$R_{0,1} = 1.2;\ \sigma_{1,r} = 0.12$	$R_{0,2} = 1.2;\ \sigma_{2,r} = 0.07$
$\rho_{pr} = 0.5$	$\rho_{pr} = 0.5$

Source: own elaboration.

Taking into account the adopted assumptions, the economic capital for the non-life premium & reserve risk of the considered two lines of business was determined on the basis of the variable:

$$Y = 0.5X_1 + 0.5X_2 \tag{10}$$

where:
X_1 and X_2 have log-normal distributions with the following parameters:
$\mu_{X_1} = -0.004299$, $\sigma_{X_1} = 0.092728$, $\mu_{X_2} = -0.002341$, and $\sigma_{X_2} = 0.068428$.

VaR proposed in Solvency II was adopted as a risk measure at the confidence level of 0.995, i.e. $\kappa(Y) = VaR_{0.995}(Y)$. The dependence structures between variables X_1 and X_2 were modelled using different copulas with parameters chosen so that the linear correlation coefficient between X_1 and X_2 was equal to the standard value of 0.5 adopted in Solvency II. Copulas and their parameters considered in the simulation analysis, along with coefficients of upper and lower tail dependences (λ_L, λ_U) are shown in the second column of Table 2. The economic capital for each dependence structure was determined taking into account the risk exposure $V = P_1 + P_2 + R_{1,0} + R_{2,0}$ as follows:

$$EC'(Y) = V \cdot EC(Y) \tag{11}$$

where:
capitals $EC(Y) = VaR_{0.995}(Y) - 1$ were determined in accordance with the simulation procedure described in the preceding Section 3 (the assumptions are as follows: $n = 100000$, $S = 1000$, and the average value of $EC^{(s)}(Y)$).

The obtained results are shown in the third column of Table 2.

Table 2. Dependence structures considered in the analysis and corresponding economic capitals

Dependence structures	Copula	Economic capital (solvency capital requirement SCR)
Str. 1	Gauss: $\rho = 0.5015$ ($\lambda_L = \lambda_U = 0$)	0.8600
Str. 2	Student: df = 20, $\rho = 0.5010$ ($\lambda_L = \lambda_U = 0.0152$)	0.8694
Str. 3	Student: df = 10, $\rho = 0.5020$ ($\lambda_L = \lambda_U = 0.0826$)	0.8785
Str. 4	Student: df = 5, $\rho = 0.5060$ ($\lambda_L = \lambda_U = 0.2102$)	0.8945
Str. 5	Student: df = 2, $\rho = 0.5250$ ($\lambda_L = \lambda_U = 0.4050$)	0.9268
Str. 6	Gumbel: $\Theta = 1.475$ ($\lambda_L = 0$, $\lambda_U = 0.4001$)	0.9374
Str. 7	Clayton: $\Theta = 1.104$ ($\lambda_L = 5337$, $\lambda_U = 0$)	0.7614
Str. 8	Frank: $\Theta = 3.710$ ($\lambda_L = \lambda_U = 0$)	0.8006
Str. 9	Galambos: $\Theta = 0.741$ ($\lambda_L = 0$, $\lambda_U = 0.3924$)	0.9386

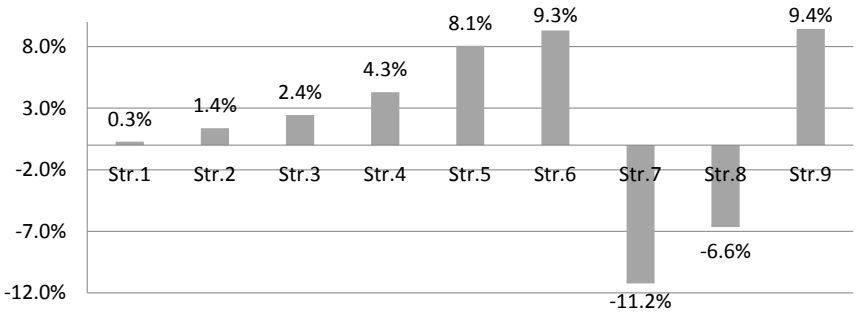
Source: own study.

For comparison, the economic capital was calculated using the standard procedure[4] proposed in Solvency II (it is called the solvency capital requirement *SCR*) to obtain the value of $EC^{Sol}(Y) = 0.8576$. It is based on the variance-covariance method in which only a linear correlation coefficient $\rho = 0.5$ is used to describe the dependence structure, regardless of the two-

[4] The procedure is described in detail, for example, in (Hürlimann, 2008; Wanat, 2011b).

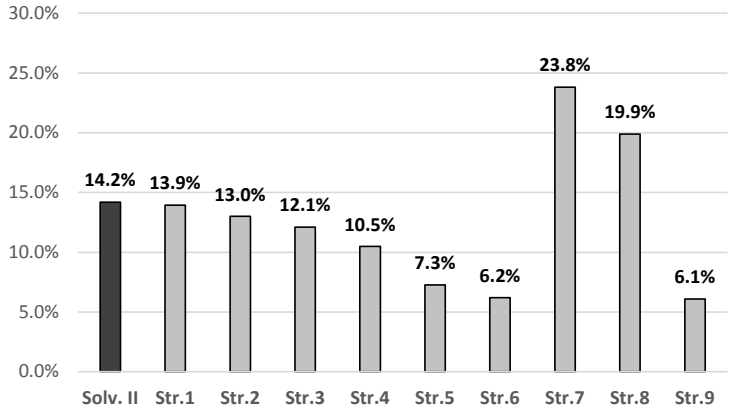
dimensional distribution of variables X_1 and X_2. Figure 1 shows the difference (in %) between the economic capital determined for the considered dependence structures and the capital determined using the standard procedure compared with the other one, i.e. $\left(EC'(Y) - EC^{Sol}(Y)\right) / EC^{Sol}(Y)$. Figure 2, in turn, illustrates the diversification effect determined using formula (2) for the considered dependence structures and the standard method.

Figure 1. Difference between the economic capital determined for the considered dependence structures and the capital determined in the standard way as a percentage of the other one



Source: own study.

Figure 2. Diversification effect for the considered dependence structures and the standard method



Source: own study.

Taking into account the results of the performed simulation study, it can be concluded that the standard Solvency Capital Requirement (CSR) proposed in Solvency II for the non-life premium & reserve risk of the considered two lines of business can lead to erroneous estimates when the dependence structure "considerably differs" from the Gaussian structure. Figure 3 shows that in the case considered, the economic capital may be underestimated even by approx. 9% in the case of upper

tail dependences (structure 5, 6 and 9) and overestimated by approx. 11% in the case of lower tail dependences (structure 7). Thus, the obtained results suggest that dependence structures between aggregated risks may be so complex that the mere correlation coefficient is not enough to describe them (they may be non-linear). Therefore, in the process of risk aggregation, it is necessary to ensure that these structures are determined as accurately as possible, and the obtained information should be included in a relevant model. Thus, to model dependence structures, a "more accurate" tool than the correlation coefficient should be used, for example the copulas applied in this paper.

5. Conclusion

Interest in the risk-based capital management methodology due to the necessity to meet the new regulatory requirements in e.g. Basel III and Solvency II. Under these projects, it is proposed to apply an approach sensitive to risk and taking into account incentives for the risk management. According to project promoters, this approach will lead to a better (optimal) allocation of capital, considering the valuation of assets and liabilities compatible with the market situation.

One of the methods of risk-based capital management is the economic capital model discussed in this paper. This method allows financial institutions to measure the risks to which they are exposed, estimate the capital necessary to cover possible unexpected losses within a certain time horizon and calculate the actual, risk-adjusted return. To use this tool correctly, it is necessary to solve a number of difficult problems, which include the method for risk aggregation discussed in this paper. The presented considerations lead to a conclusion that the choice of an aggregation method largely depends on the structure of dependences between risk types (or risk factors) taken into account in a model. Therefore, research on methods for risk aggregation should focus on developing tools to obtain as much information about the dependence structure as possible on the basis of skimpy statistical data and tools that allow one to use this information effectively when determining the distribution of the aggregate risk.

Dependences and correlations have also become particularly significant in the context of the recent financial crisis in the banking sector. Since the diversification effect estimated on their basis has a fundamental impact on capital solvency requirements, comments can be heard that "the blame lies with the Gaussian copula because it does not capture dependences in the distribution tail", "the correlation was underestimated" or even that "everything that relies on a correlation is charlatanism". Of course, it is not the models which are to be blamed, but their application without checking relevant assumptions. There is a clear need for better understanding of dependences and correlations and their limitations, if we want to avoid a repetition of the experience of this crisis.

A copula is a tool that enables one to identify the actual dependence structure and then to take it into account in the process of estimating the economic capital. It has both advantages and disadvantages. The main advantages of using copulas include:

- the ability to model "richer" dependence structures than in the case of using a linear correlation,
- the ability to model extreme events and dependences in tails,
- the ability to "separate" the dependence structure from marginal distributions, which makes them a convenient tool to simulate distributions of multidimensional risk variables necessary in scenario analyses and stress tests,
- a relatively simple method for combining them with other models, which is particularly important in the case of integrated risk management systems.

On the other hand, the main disadvantages may include the requirement of a quite large amount of empirical data necessary to estimate copulas, as well as some difficulties in deciding which of them should be selected to describe a multivariate distribution. Despite these drawbacks, copulas seem to be convenient tools to introduce dependence structures to the process of estimating the economic capital.

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Chapter 2

The Random Subspace Method in the Prediction of the Risk of Bankruptcy of Companies in Poland[1]

Barbara Pawełek, Dorota Grochowina

1. Introduction

The theme of the article is tackled in research on enterprise bankruptcy which is an important economic problem. The issues related to the assessment of the risk of enterprise bankruptcy have been widely discussed in economic literature (e.g. Altman, 1968; Ohlson, 1980; Frydman et al., 1985; Odom & Sharda, 1990). This proves both the importance of the topics discussed in this paper in economic sciences and their current validity. When it comes to the examination of the risk of enterprise bankruptcy, works are continued on the methodology of predicting first and subsequent bankruptcies (e.g. Altman & Branch, 2015; Eberhart et al., 1999; Platt & Platt, 2002) and evaluation of the financial standing of enterprises following the declaration of bankruptcy (e.g. Kostrzewska et al., 2016). The major methodological problems occurring in the forecasting of enterprise bankruptcy include the selection of research set type (balanced or unbalanced), choice of objects in the balanced set (random or non-random), choice of bankruptcy prediction method, selection of explanatory variables, lack of data, evaluation of the prediction accuracy of analysed methods, etc. (e.g. Pociecha et al., 2014; Sun et al., 2014; Yu et al., 2014).

The forecasting of bankruptcy risk for enterprises can be based on one model (classical approach) or multiple models (multi-model approach). The multi-model approach involves the combination of M base models $D_1, ..., D_M$ into one aggregated model D^* for the purpose of improving the accuracy of forecasting (Gatnar, 2008, p. 62). One of the conditions for achieving the mentioned goal of using a multi-model approach is to use diversified base models. Increased diversification of base models can be obtained as a result of, for example, (Gatnar, 2008, pp. 138-169):

- random selection of observations, e.g. bootstrap aggregating (bagging) method, boosting method,
- random variable selection, e.g. random subspace method, random forest method, or

[1] Publication was financed from the funds granted to the Faculty of Management at Cracow University of Economics, within the framework of the subsidy for the maintenance of research potential.

- transformation of dependent variable, e.g. error-correcting output coding.

The article is aimed at presenting results of empirical research on the suitability of the application of random subspace method in the forecasting of enterprise bankruptcy risk.

The paper presents the results of analysis conducted for classification trees. A classification tree is a method for recurrent division of the examined set into disjoint sets until obtaining homogeneity due to the distinguished characteristic. The application of the method leads to decision-making rules which allow for ordering objects in the considered subsets.

Calculations and drawings were made in R software, with the use of scripts by E. Gatnar (2008) modified for the purpose of the conducted empirical research.

2. Databases and research procedure

The research was based on a set of 7223 enterprises operating in the industrial processing sector in Poland. Forty-two enterprises were taken into account for which court declared bankruptcy during the years 2014 and 2015 (bankrupt companies, B). Financial data concerned the period of 2013 and 2014, so it was taken from financial statements published a year before declaring bankruptcy. The database also includes 7181 financially sound enterprises, that is those which continued their business operations during the years 2014 and 2015 (non-bankrupt ones, NB). The main area of operations and the availability of financial data for the years 2013 and 2014 were some of the selection criteria of financially sound enterprises for the dataset. Data was retrieved from the Emerging Markets Information Service website. Enterprises which declared bankruptcy constituted approximately 0.6% of all enterprises in the database. The risk of bankruptcy was forecasted one year in advance.

Based on the input dataset, two research sets were created:

- variant I: balanced set: 42 B – ½ of the whole set and 42 NB – ½ of the whole set (84 objects in total),
- variant II: non-balanced set: 42 B – ¼ of the whole set and 126 NB – ¾ of the whole set (168 objects in total).

Financially sound enterprises were selected randomly for the examined sets and the choice was repeated 30 times. Each of the sixty tested sets (30 balanced sets and 30 unbalanced sets) was randomly divided (100 times) into the training part (2/3 of the entire set) and the testing part (1/3 of the entire set).

The examination involved:

- a dummy variable which took category "1" in case of enterprises which declared bankruptcy in 2014 or 2015 and category "0" for "sound" ones,
- sixteen financial ratios divided into the following groups: liquidity ratios (3 variables), debt ratios (4 variables), profitability ratios (5 variables), efficiency ratios (4 variables).

The research was performed for a CART tree (Classification and Regression Trees). Base models were built based on randomly selected explanatory variables. The random subspace method was used to reduce the dimension of variable space. On the basis of the built models, enterprises were classified into two groups: a group of entities which are not in risk of bankruptcy in a year ("NB" group) and a group of entities which are in risk of bankruptcy in a year ("B" group). The aggregation of base models, i.e. combining forecasting outcomes with the use of base models was carried out in accordance with the majority vote method (Gatnar, 2008, p. 63).

The following measures were used to evaluate the classification effectiveness of models:

- total error (percentage of enterprises incorrectly classified in "B" group or "NB" group),
- type I error (percentage of bankrupt enterprises classified in "NB" group),
- type II error (percentage of financially sound enterprises classified in "B" group).

The evaluation of the usefulness of random subspace method for the forecasting of enterprise bankruptcy risk was based on the value of classification efficiency measures for enterprises belonging to the testing set.

3. Results of empirical research

The conducted analyses covered three research tasks:

- task I: comparison of the values of classification efficiency measures calculated for the aggregated model D^* and base models $D_1, ..., D_M$ for the selected research test,
- task II: determining the optimum number of base models,
- task III: determining the optimum number of variables.

3.1. Task I

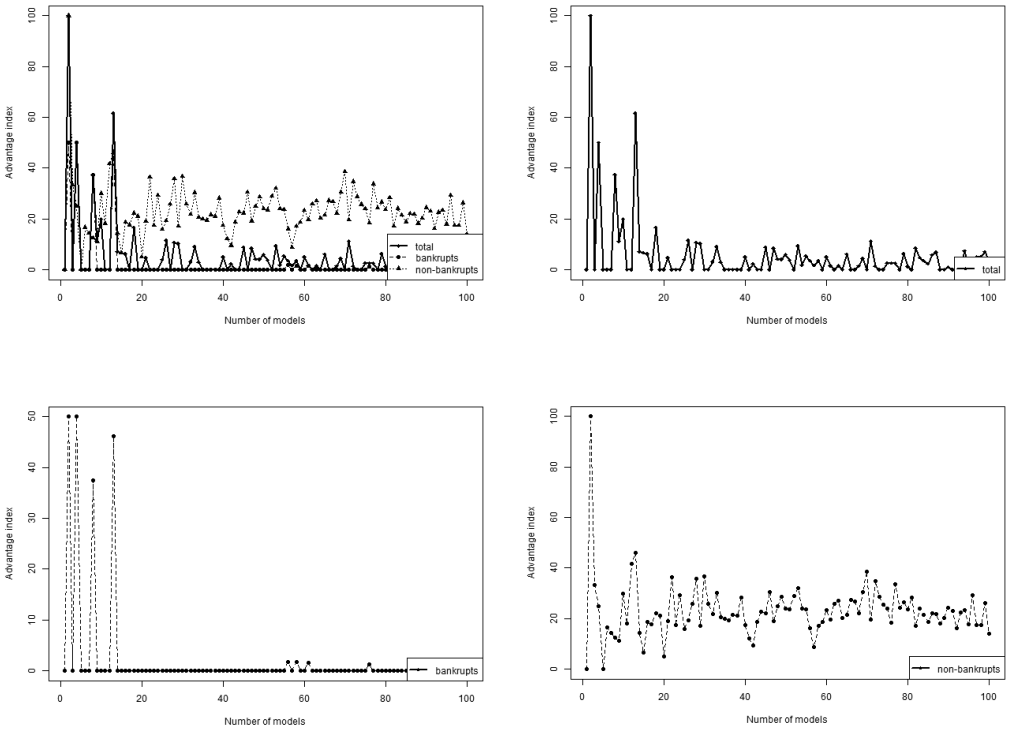
For the first set of thirty constructed balanced sets and the first of thirty constructed unbalanced sets as well as the first of 100 random divisions into the training and testing parts, the random subspace method was used, with 4, 8 or 12 variables and 1 to 100 base models. The variant with one base model corresponds with the classical approach.

The values of classification efficiency measures calculated for the aggregated model D^* and base models $D_1, ..., D_M$ were compared with the use of the ratio which informs about the advantage of base models over the aggregated model. The ratio was calculated as follows:

- it was determined how many base models of M analysed models ($M = 1, ..., 100$) had the value of a given classification efficiency measure lower than the value of the measure calculated for the aggregated model M^*,
- the obtained number was divided by the number of models M and multiplied by 100.

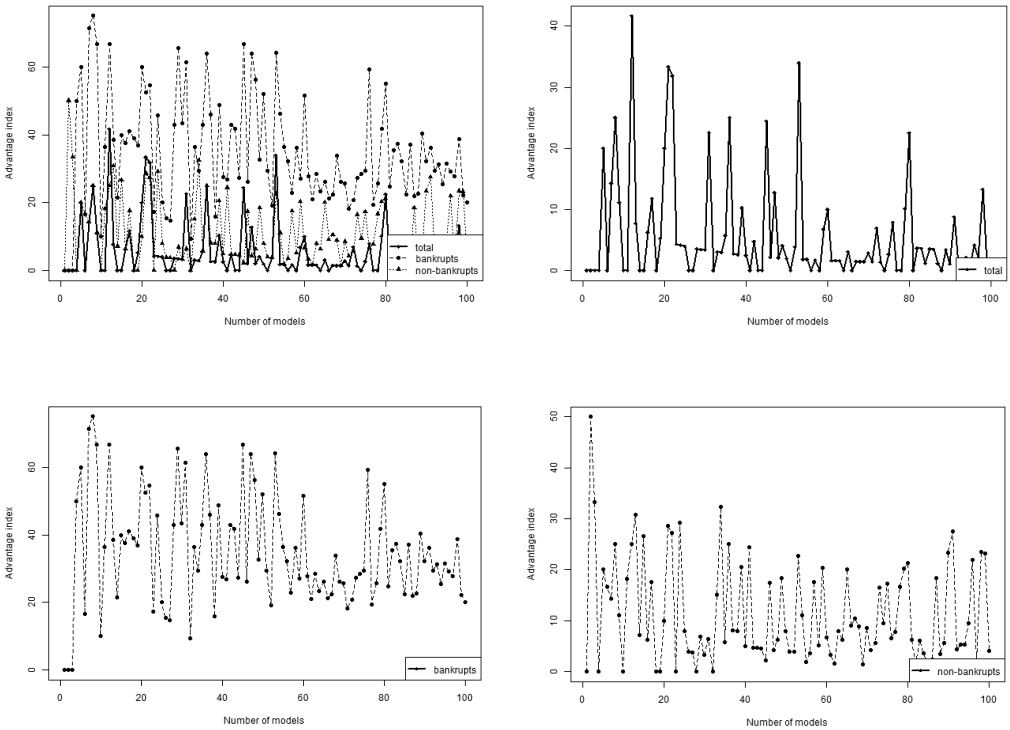
Selected results are presented above. They indicate that attempts at using the multi-model approach to forecasting bankruptcy risk one year in advance are justified. Figure 1 shows values of the advantage index of base models over the aggregated model for the considered balanced set in case of reducing the size of variables space to ½ of the input size (i.e. 8 variables). Figure 2, in turn, presents results obtained for the exemplary unbalanced set in case of reducing the size of variables space to ¼ of the input size (i.e. 4 variables).

Figure 1. Advantage index of base models over the aggregated model for the selected balanced set – 8 financial ratios



Source: own study.

Figure 2. Advantage index of base models over the aggregated model for the selected unbalanced set – 4 financial ratios



Source: own study.

In case of 8 variables and a balanced set (Fig. 1), it can be noted that the use of approximately 20 or more base models is conducive to the accuracy of forecasting in general and in the group of bankrupt companies. The advantage of base models over the aggregated model in the group of financially sound enterprises oscillates around the level of 20%.

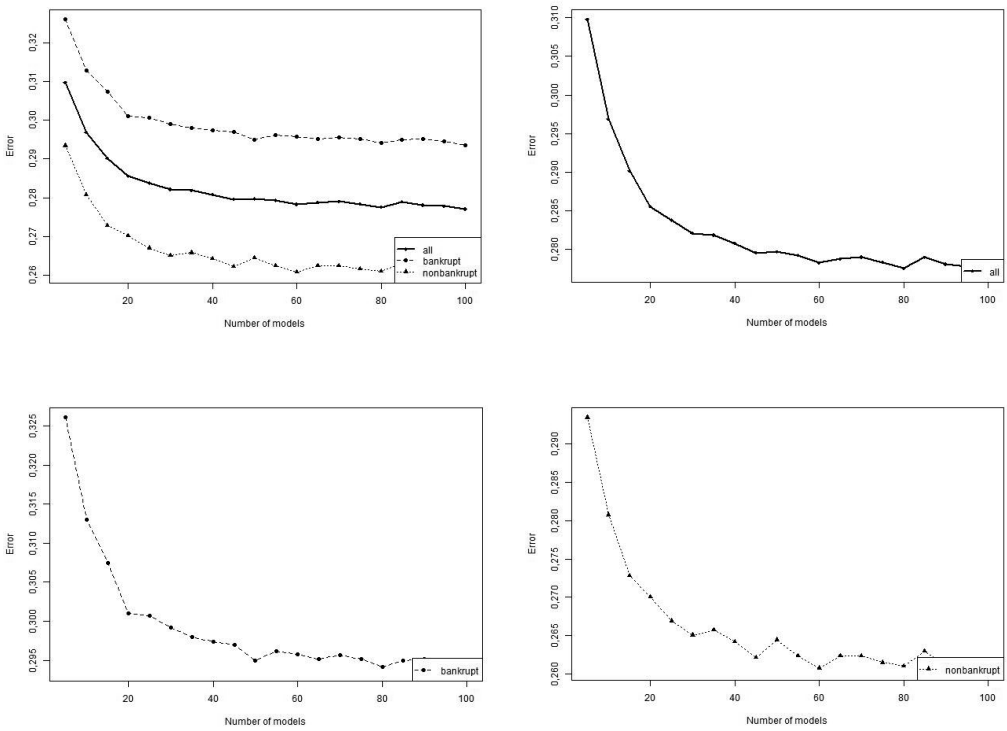
The reduction of the size of variables space to 4 in case of an unbalanced set gave better results that the reduction to 8 variables. In case of 4 variables and an unbalanced set (Fig. 2), it can be noted that the use of approximately 20 or more base models is conducive to the decreased advantage of base models over the aggregated model. The reduction of the variables space to 4 in case of a balanced set gave worse results that the reduction to 8 variables.

3.2. Task II

In order to determine an optimal number of base models separately for balanced and unbalanced sets, the analysis covered 30 research sets for each set type and 100 divisions into the training part and testing part of each of these sets. Calculations were conducted with the assumption of the reduction of the size of variables to ¼, ½ or ¾ of the input size. Aggregated models were constructed

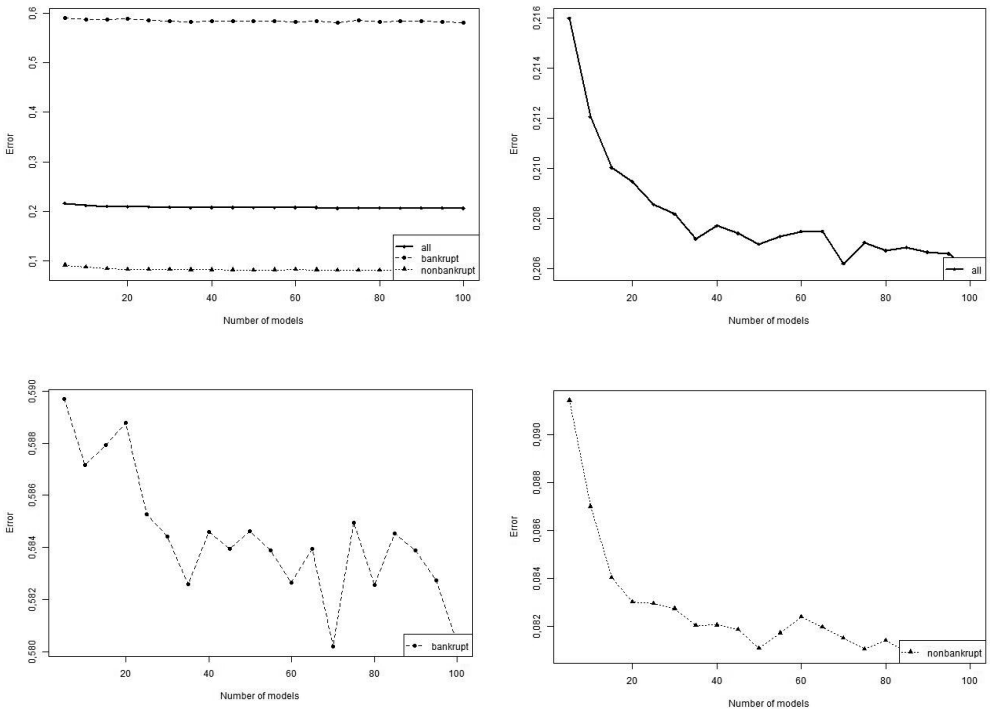
based on 5, 10, 15, ..., 100 models. For each reduction variant of the space of variables, average value of the considered classification efficiency measures was calculated. Based on the obtained results, it was stated that the reduction of the space of variables to ¾ of the input size (i.e. 12 variables) does not lead to the improvement of the forecasting accuracy with the use of the random subspace method. Satisfactory results were obtained in case of reducing the variables space to ¼ or ½ of the input size. For example, Figures 3 and 4 present results obtained with the assumption that 4 variables are randomly taken out of 16 ratios (i.e. ¼ of the input dimension).

Figure 3. Prediction error for the balanced set – 4 financial ratios



Source: own study.

Figure 4. Prediction error for the unbalanced set – 4 financial ratios



Source: own study.

For both types of research set (balanced and unbalanced), it can be noted that the adoption of approximately 30 or more base models allows for reducing the percentage of misclassified enterprises.

The obtained results also suggest the problem with classifying bankrupt companies in case of an unbalanced set. It seems that the problem may be caused by insignificant diversification of base classification trees when it comes to the recognition of enterprises which form a small group of objects among the analysed entities. This requires further examination both when it comes to the assessment of the legitimacy of the above presumptions and, after confirming the indicated cause, of the proposed solution to the problem of bankrupt classification accuracy.

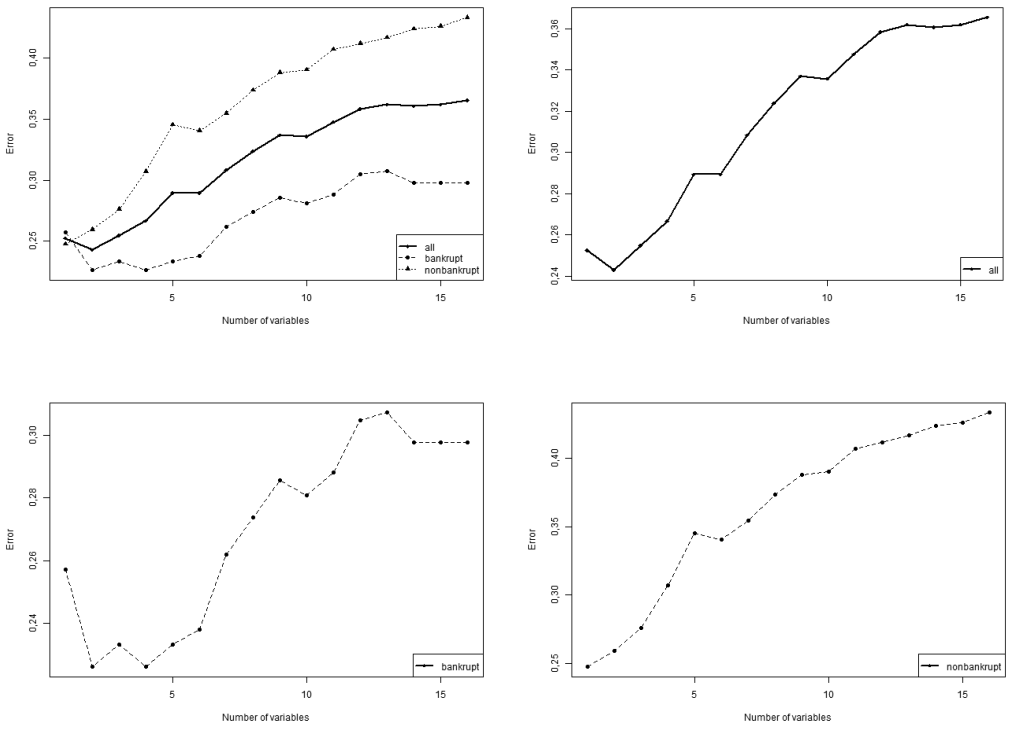
3.3. Task III

The optimum number of variables was determined in a similar way as in item 3.2. However, in this case, the number of models was set at the level of 30, 50, 70 or 90 models and the number of variables ranged from 1 to 16 ratios. In all of the analysed variants of the number of models, similar results were obtained, so Figures 5 and 6 present example results for 90 models.

Based on the analysis of Figures 5 and 6, it can be stated that the adoption of 2 or 4 ratios leads to the reduction of the percentage of misclassified bankrupt companies in case of a balanced set.

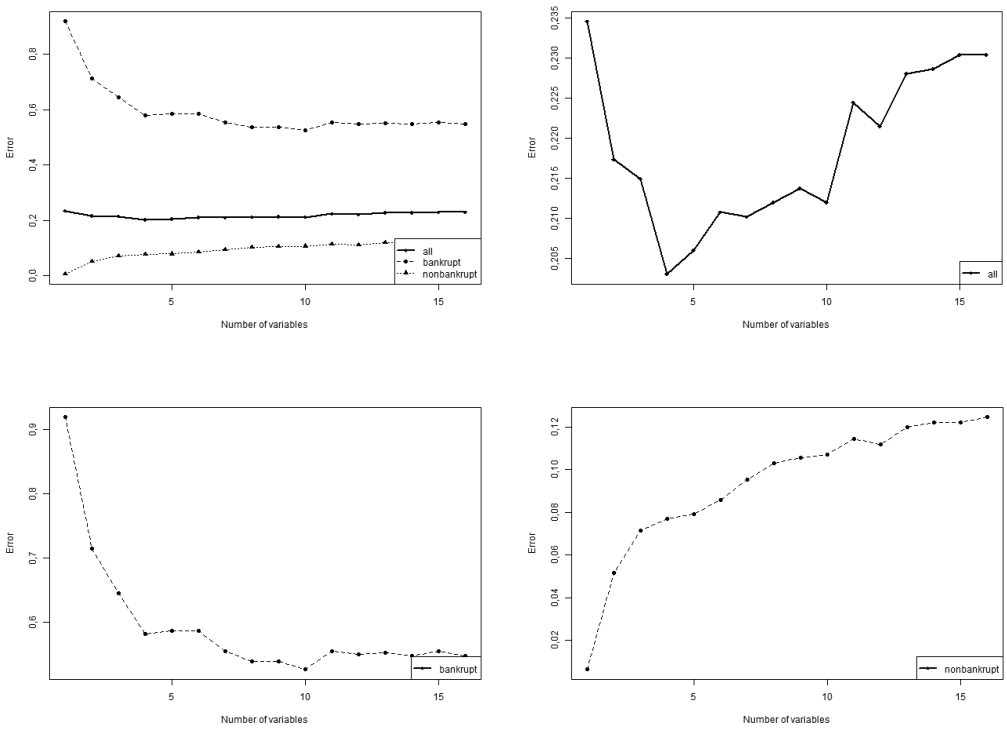
The reduction of the size of variables space to 4 or 8 ratios allows for obtaining improved classification efficiency of bankrupt companies in case of an unbalanced set.

Figure 5. Prediction error for the balanced set – 90 base models



Source: own study.

Figure 6. Prediction error for the unbalanced set – 90 base models



Source: own study.

For both types of the research set, an increase in the percentage of misclassified financially sound enterprises can be observed, along with the increase in the number of ratios which form the basis for building classification trees. But in both cases, the error does not exceed 0.5.

4. Conclusion

The application of the random subspace method for the forecasting of enterprise bankruptcy risk may lead to improved accuracy of forecasting one year in advance, based on classification trees. However, further research on the usefulness of the multi-model approach for the forecasting of enterprise bankruptcy risk is required, including research on the diversification of base models.

Based on the presented results of empirical research, it can be stated that the random subspaces method is more useful for the forecasting of enterprise bankruptcy risk one year in advance based on classification trees constructed with the balanced set of objects than in case of using an unbalanced set of objects.

The calculations indicate that the size of variables space should be reduced to ¼ or ½ of the input size of the set of variables and aggregation of 30 to 100 base models in case of the random

subspace method in the forecasting of enterprise bankruptcy risk one year in advance, based on classification trees.

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Chapter 3

Measuring the Risk of Option Portfolios. The Case of the Delta Hedged Portfolio[1]

Ryszard Węgrzyn

1. Introduction

Option portfolios range from small baskets of vanilla options on the same underlying asset to very large collections of different products on many underlying assets. The most important risk factors for option portfolios are the underlying asset price and their implied volatility surface. To assess the option risk we use the option's sensitivities to its risk factors, called the Greeks. The first and the second order partial derivatives (sensitivities) of the option price with respect to the underlying price are delta and gamma. The first order partial derivative of the option price with respect to the underlying volatility is vega. The two other minor Greeks are: theta, a partial derivative of the option price with respect to time, and rho, a partial derivative with respect to the interest rate (see: Węgrzyn, 2013, pp. 67-73). Very often option portfolios that are held by institutional investors are managed to be delta neutral, delta-gamma neutral or delta-gamma-vega neutral. Especially in this case investors need to asses the risks they are taking before and after hedging.

The aim of the paper is to draw attention to the problems of measuring the risk of option portfolios. Especially a delta hedged portfolio will be the object of a detailed analysis.

The paper consists of a part which describes risk mapping of option portfolios to their risk factors, a part explaining the problems connected with VaR measurement, and an empirical part concerning VaR estimation for an unhedged and hedged portfolio, as well as the introduction and conclusions. In the empirical part, empirical data from the Warsaw Stock Exchange were used for analysis.

2. Mapping of option portfolios to price risk factors

Option portfolios are usually mapped to their risk factors using Taylor approximation. A Taylor expansion may be used as a local approximation to the change in the value of an option portfolio as a function of small changes in its risk factors. When the sensitivities to the price risk factors

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(delta, gamma) and the sensitivity to the volatility risk factor (vega) are expressed in value terms, the risk factor sensitivities are additive across different portfolios. It allows to approximate the P&L of an option portfolio using Taylor expansion as a sum of risk factor changes weighted by the portfolio's net value delta, gamma, vega and possibly other Greeks.

The delta-gamma approximation is a quadratic risk factor mapping that captures the non-linearity of the option portfolios. When all the options in the portfolio are on the same underlying, it may be written down as

$$P\&L \approx \delta^{\$} R + 0.5\gamma^{\$} R^2 \tag{1}$$

where:
R $= \Delta S/S$,
S – the underlying price,
$\delta^{\$}$ – the value delta, and
$\gamma^{\$}$ – the value gamma.

The quadratic function applied to this approximation indicates that a portfolio with positive gamma has a convex P&L profile and a portfolio with negative gamma has a concave P&L profile. In the case of an option portfolio with positive gamma, upward price moves are enhanced and downward price moves are diminished. The opposite is the case for a portfolio with negative gamma. Therefore, independently of the sign of delta, all option portfolios with positive gamma have less price risk than those with negative gamma. It is so called gamma effect (Alexander, 2008a, pp. 346-347).

The general expression for the delta-gamma-vega-theta-rho approximation to the P&L of a portfolio of options on the same underlying is

$$P\&L \approx \theta^{\$}\Delta t + \delta^{\$} R + 0.5\gamma^{\$} R^2 + \nu_{\$}^{'}\Delta\sigma + \pi_{\$}^{'}\Delta r \tag{2}$$

where:
$\theta^{\$}$ – the value theta, Δt is a change in time,
$\nu^{\$}$ – the value vega vector,
$\Delta\sigma$ – the vector of changes in implied volatilities, one for each option,
$\pi^{\$}$ – the value rho vector, and
Δr – the vector of discount rates with maturities equal to those of the options.

Each option in a portfolio has its own implied volatility. Even when all options in the portfolio are on the same underlying asset, the implied volatility is different and depends on the strike price and the maturity of the option. In this case, we need to consider the entire implied volatility surface. Therefore, in a large portfolio it is necessary to reduce the number of volatility risk factors. Usually this can be done by vega bucketing or volatility beta mapping (see: Alexander, 2008a, pp. 355-357).

The so-called vega effect can strengthen or weaken the effect of delta. It depends on the relationship between the underlying price and volatility. If the underlying price and volatility are negatively and symmetrically related, the vega effect enhances the delta effect for a put option

and recompenses the delta effect for a call option. However, on the stock market, the asymmetric negative price-volatility relationship has been empirically confirmed. In this case, the vega effect on a long put position or short call is negligible (Alexander, 2008b, pp. 252-253).

Since option prices generally decrease with time, the theta effect is to increase the risk of long positions and decrease the risk of short positions, whereas the rho effect on portfolio risk results from changes in interest rates. Therefore, it is typically very small.

3. Value at risk of an option portfolio

Determining the risk of option portfolios is usually related to VaR estimation based on the adopted model arising from the applied approach. The basic approaches are: analytic approximation, historical simulation and Monte Carlo simulation.

The mapping of option portfolios to the underlying prices allows an analytic approximation to the VaR of an option portfolio. Based on the expression for the delta approximation to the P&L of a portfolio of options on the single underlying, we can apply normal linear VaR formula to approximate the 100α% *h*-day VaR of the option portfolio as

$$VaR_{h,\alpha} \approx \delta^{\$} \times \Phi^{-1}(1-\alpha)\sigma_h \tag{3}$$

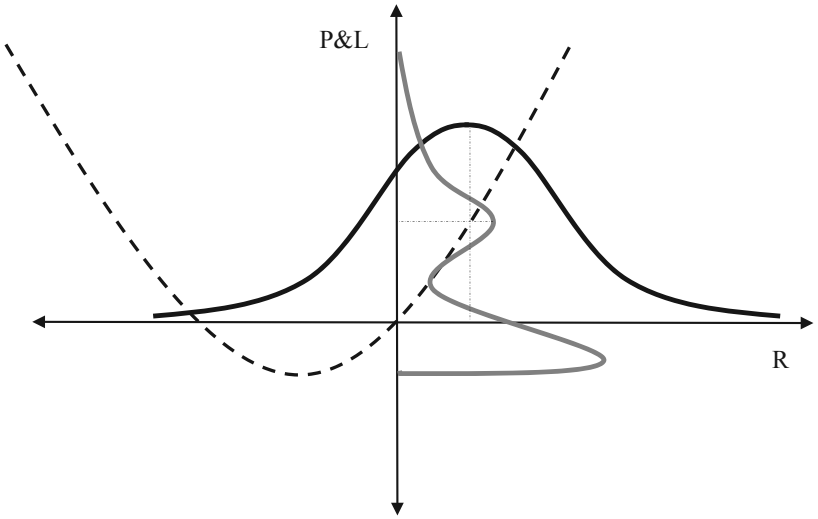
where:
$\delta^{\$}$ – the delta value of the portfolio,
$\Phi^{-1}(1-\alpha)$ – the 1– α quantile of the standard distribution.

We assumed that the discounted *h*-day returns on the underlying asset are normally distributed with mean μ_h and standard deviation σ_h. Because the option pricing theory is based on the assumption that the expected return on the underlying asset is the risk free discount rate, we set $\mu_h = 0$ (Alexander, 2008b, p. 257).

But a linear risk factor mapping is very inaccurate for an option portfolio. So the delta-normal VaR model should not be used. In Figure 1 we illustrate after C. Alexander (2008b, p. 260) the P&L distribution resulting from the delta-gamma approximation. The distribution of returns R on a single underlying asset is assumed to be normal and its density is shown by the black curve. The delta-gamma approximation is a quadratic function of R, which is indicated by the dashed curve, and the option portfolio P&L density given by the delta-gamma approximation is shown by the grey curve. As we can see, the P&L distribution, which is derived by applying this approximation to each value of R, is positively skewed, bimodal and may also be highly leptokurtic.

We can derive an analytic approximation to the delta-gamma VaR of a portfolio of options (see: El-Jahel, Perraudin & Sellin, 1999; Castellacci & Siclari, 2003; Chen & Yu, 2013; Cui, Zhu, Sun & Li, 2013), but we need to fit a P&L distribution with density function, such as shown in Figure 1. After calculating the first four moments we can apply a Cornish-Fisher expansion or a Johnson SU distribution to approximate a quantile on their basis. However, the P&L distribution is bimodal and highly skewed, and it is very difficult to capture a parametric model. This problem occurs especially when calculating the VaR at extreme quantiles. Even small differences between the parametric model and the empirical distribution can lead to large errors in the VaR estimates.

Figure 1. The P&L distribution resulting from the delta-gamma approximation



Source: (Alexander, 2008b, p. 260).

Another approach to VaR estimation is historical simulation whose application is analyzed in the next part of the paper. An advantage of this approach is that it can be applied both to linear and non-linear portfolios. In this case there is no assumption about the parametric form of the distribution of the risk factors returns, but it is assumed that any possible future changes took place in the past. It imposes very strict data requirements. Recommended large sample sizes in the case of options which usually expire within one year are unrealistic.

The problem can be solved by estimates on the basis of the historical data for underlying assets, risk-free interest rates and implied volatility, based on the adopted model of option valuation. On the Polish option market, however, calculated implied volatility indices are not available. In this case, one can only use the volatility estimated by means of a specific model.

A very flexible approach to VaR estimation, which can be used both for linear and non-linear portfolios, is Monte Carlo simulation. The Monte Carlo simulation method is particularly applied in the situations when the data concerning changes in the portfolio asset prices are not easily available or insufficient for the analysis with the historical simulation method. By using the Monte Carlo simulation method, one can obtain sets of artificially created events of any size on the basis of which VaR is calculated.

Monte Carlo simulation is a method of generating scenarios that mimic a process and then finding the average values of the scenarios to approximate the outcome of the process. In principle, it utilizes the law of large numbers, i.e. the mean value of a sample chosen from a finite population is equal to the true mean of the population when the sample is considerably large.

In the simplest Monte Carlo simulation the risk factor dynamics are assumed to be governed by an i.i.d. multivariate normal process. However, very often this distributional assumption is not appropriate. We need to build a model for return distributions which accurately represents their empirical behaviour (see: Glasserman, 2004). In more general Monte Carlo frameworks, the risk factors returns could have a joint distribution with different marginals and with risk factor depend-

ency represented by a copula. Also multi-step techniques could be applied to simulate realistic dynamic features as volatility clustering in risk factors returns.

The implied volatility in Monte Carlo simulation is treated like any other stochastic risk factor, having its own expected return and volatility (see: He, 2012). The simulation of the underlying price and volatility must also take into account their dependence. On the stock market the price and volatility usually have an asymmetric, nonlinear relationship. It is possible to derive simulations on the volatility risk factor via an estimated price-volatility model (Alexander, 2008b, pp. 283-290).

The full Monte Carlo simulation is the methodology that involves randomly drawing risk factors from a given distribution or historical sample or other scheme, feeding the values obtained for every draw to the corresponding valuation formulas or algorithms, computing the resulting portfolio values and finally gathering those sought for quantile from the empirical distribution of such portfolio values. The quadratic portfolio assumption (delta-gamma approximation) leads to a delta-gamma Monte Carlo simulation, which is conceptually simple, significantly more accurate than most analytic methodologies, and less computationally expensive than full Monte Carlo. The delta-gamma Monte Carlo simulation does not require distributional assumptions on the risk factors or the computation of the moments of the distribution (unlike most parametric methodologies), and it does not require exact revaluation of every position in a given portfolio (Castellacci & Siclari, 2003). Therefore, this approach based on the risk mapping is very practical, although very simplified and not entirely suitable.

4. Historical VaR of the unhedged and delta hedged portfolios

This part will present VaR analysis with the use of the historical simulation method, based on the data from previously conducted research into the application of delta hedging with respect to the portfolio consisting of stocks included in the WIG20 Index and the WIG20 Index options.

Generally, dynamic hedging consists in hedging the portfolio consisting of the underlying asset and options by constructing the portfolio in such a way so that stock prices were recompensed by changes in the option price. For proper construction of a portfolio, Greeks are used. The most important Greeks in the context of portfolio hedging include delta, gamma and vega.

The basic type of dynamic hedging is delta hedging, consisting in the application of delta coefficient to determine the portfolio structure. This type of hedging protects against small changes in the underlying price. As the delta coefficient for a call option has positive values from a range (0;1), and for a put option it has negative values from a range (-1;0), in order to obtain delta for the whole portfolio equal to zero, it is necessary to take adequate positions within specific options. Hedging the stock buying position requires taking a position of selling an appropriate amount of call options or buying an appropriate amount of put options (short call or long put) (see: Węgrzyn, 2013, pp. 91-101).

In the conducted empirical research the adopted research method was the historical scenario method in which it was assumed that the market participant hedged the stock portfolio corresponding to the WIG20 Index in the whole analyzed period. Firstly, he defined the portfolio content which he modified by the end of each trading session, based on each time calculated amounts of adequately selected options. Call options at the strike price closest to the current level of WIG20 Index and with the closest expiration date were used for hedging. The conducted research covered the period from 2 July 2007 to 31 January 2008. Therefore, the WIG20 Index options listed in that

period were used in delta hedging. Those were call options expiring on 21 September 2007, 21 December 2007 and 20 March 2008 with various strike prices adjusted to the WIG20 Index level.

To determine the amount of the index and a given option in the portfolio, delta coefficients were used. In this case, at the beginning it was assumed that the amount of the index (stocks) in the portfolio does not change and is equal to 10, whereas the amount of options was defined as the inverse of delta coefficient multiplied by 10 and each time rounded to the integer. That operation was performed because of the indivisibility of options contracts, but it did not cause any significant changes in the achieved results of the hedging. In this case one should also remember about the multiplier occurring with respect to the index and option prices expressed in points, which is PLN 10/point. For detailed computations, data from the Warsaw Stock Exchange concerning option prices and the levels of the WIG20 Index, as well as delta coefficients for individual options calculated by the stock exchange were used.

The 100α% *h*-day historical VaR, in value terms, can be defined as the α quantile of an empirical *h*-day discounted P&L distribution. But, when we calculate the percentage VaR on the basis of returns, the 100α% *h*-day historical VaR is the α quantile of an empirical *h*-day discounted return distribution.

In the case of estimating the1% VaR it is believed that the sample size should be at least 2,000 daily observations. As a result of the conducted analysis, the total of 146 observations were obtained, which means that the VaR estimates should be treated very carefully.

The historical VaR based on an equally weighted return distribution depends very seriously on the sample size. The equal weighting of returns data makes any extreme market movement have the same effect on the VaR estimate, whether it happened years ago or yesterday. When data are equally weighted, the VaR will not properly reflect the current market conditions. For this reason, VaR models should apply some type of weighting to the returns data.

The two different ways of weighting the risk factor returns are: exponential weighting of probabilities and volatility adjustment of returns. The first way is to use the exponentially weighted moving average method. This method is simple to apply, but the quantiles depend largely on the value chosen for the weighting constant. The choice of the constant is entirely *ad hoc*.

The volatility adjustment method is designed to weight returns in such a way that we adjust their volatility to the current volatility. The first step in this method is to obtain a time series of volatility estimates for the historical sample of returns. We can do this by using an appropriate GARCH model. The second step is to calculate the volatility adjusted returns. The unadjusted return (r_t) at every time $t < T$ is multiplied by the volatility estimated at time $T(\hat{\sigma}_t)$ and divided by the volatility estimated at time $t(\hat{\sigma}_t)$. That means that the volatility adjusted returns series is:

$$\tilde{r}_{t,T} = \left(\frac{\hat{\sigma}_T}{\hat{\sigma}_t} \right) r_t \tag{4}$$

where:
T – fixed but t varies over the sample {t = 1,…,T}.

In the analyzed case, to estimate volatility the GARCH and A-GARCH models were used in their simplest form. As a result of the estimates, the parameters of the models were obtained, both for unhedged portfolio and hedged portfolio returns (see: Tab. 1).

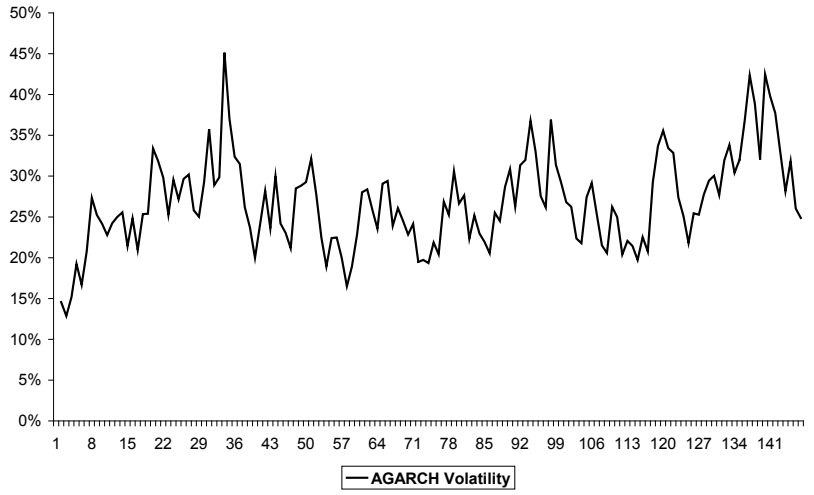
Table 1. Parameter estimates

Parameter	Unhedged portfolio returns		Hedged portfolio returns	
	GARCH	AGARCH	GARCH	AGARCH
w	0.0001	0.0000	0.0000	0.0000
a	0.0477	0.0793	0.4351	0.4471
b	0.7191	0.6515	0.5365	0.5224
l	-	0.0323	-	0.0023
a+b	0.7669	0.7308	0.9716	0.9695
Long term volatility	25.46%	27.76%	30.08%	30.72%
Log likelihood	520.29	526.76	624.90	626.31

Source: own elaboration.

The A-GARCH model captures the asymmetric response of volatility to the rises and falls in the portfolio returns. The symmetric GARCH model ignores this effect, and hence underestimates the long term average volatility over the sample. The log likelihood is also higher in the asymmetric GARCH model in both cases. The resulting A-GARCH volatility estimates of unhedged portfolio returns are shown in Figure 2. As we can see, volatility varies considerably over the sample period, from about 13% to 45% on an annualized basis.

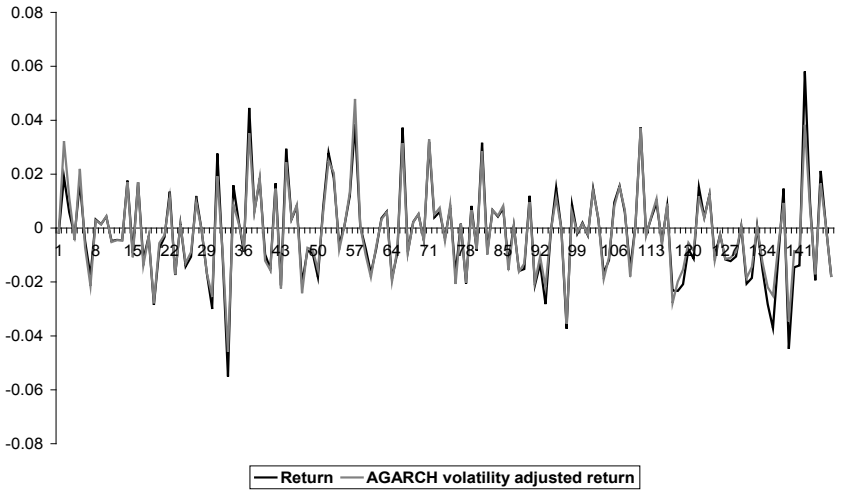
Figure 2. A-GARCH volatility estimates



Source: own elaboration.

In the second step we made the calculation of the volatility adjusted returns. Figure 3 illustrates the A-GARCH volatility adjusted returns and the unadjusted returns of an unhedged portfolio. As we can see in some cases, these values vary significantly.

Figure 3. The comparison of the volatility adjusted returns



Source: own elaboration.

After the adjustment of returns we estimated historical VaR for an unhedged portfolio and a hedged portfolio, based on the unadjusted returns and based on the volatility adjusted returns with both the symmetric and the asymmetric GARCH volatilities.

The results of the estimates are presented in Table 2. On their basis we can see that VaR calculated based on the adjusted returns to a great extent depends on the volatility model applied for adjustment. Applying the volatility adjustment from the A-GARCH model, the VaR level is generally lower than the VaR level for volatility adjusted returns from the GARCH model. In this case, as it can be seen, the choice of a model is of great significance. On the other hand, as far as the hedged portfolio risk is concerned, in each case, regardless of the applied approach and the adopted quantile, VaR for a hedged portfolio is by far lower than VaR for an unhedged portfolio.

Table 2. Historical 1-day VaR of the portfolio returns

Quantile	Unhedged portfolio			Hedged portfolio		
	Unadjusted	Volatility adjusted		Unadjusted	Volatility adjusted	
		GARCH	A-GARCH		GARCH	A-GARCH
0.1%	5.36%	5.62%	4.44%	4.31%	3.28%	3.15%
1.0%	4.14%	4.43%	3.51%	2.69%	2.70%	2.42%
5.0%	2.68%	2.97%	2.37%	1.18%	1.75%	1.57%
10.0%	2.06%	2.21%	1.99%	0.91%	1.19%	1.23%

Source: own study.

When we use a very large sample and measure quantiles no less than 1%, for 1-day VaR we need the volatility adjusted daily portfolio returns, and for VaR with horizons longer than 1 day we can apply the multi-step historical simulation (see: Barone-Adesi et al., 1998, 1999). This idea

is to use a parametric dynamic model of returns volatility to simulate log returns on each day over the risk horizon.

But when we use not a large sample or measure very extreme quantiles, we need to fit a continuous distribution to the empirical one. In that case, we can apply the Johnson distribution which is appropriate if the portfolio returns are highly skewed or leptokurtic. The 100α% *h*-day historical VaR of the portfolio under the Johnson SU distribution is

$$VaR_{h,\alpha} = -\lambda \sinh\left(\frac{z_\alpha - \gamma}{\delta}\right) - \xi \tag{5}$$

where:
ξ – determines the location of the distribution,
λ – determines the scale,
γ – the skewness,
δ – the kurtosis,
sinh – the hyperbolic sine function and
z_α – the corresponding standard normal quantile: $z_\alpha = \Phi^{-1}(\alpha)$, Φ is the standard normal distribution function.

In the analyzed case, due to a relatively small sample, the Johnson SU distributions were adjusted to empirical distributions, using an algorithm proposed by H. Tuenter (2001) to estimate the parameters. On the basis of the four first moments of portfolio returns (see: Tab. 3) parameters for Johnson SU distributions were estimated first, and then adequate VaR levels were calculated (see: Tab. 4).

Table 3. The statistics of the portfolio returns

Statistics	Unhedged portfolio			Hedged portfolio		
	Unadjusted	Volatility adjusted		Unadjusted	Volatility adjusted	
		GARCH	A-GARCH		GARCH	A-GARCH
Mean	-42.36%	-43.81%	-39.31%	-6.57%	-6.23%	-6.65%
Standard deviation	27.03%	29.69%	24.75%	14.65%	14.72%	14.09%
Skewness	0.3215	0.3409	0.3762	-0.9333	-0.5949	-0.4660
Kurtosis	1.2212	0.9100	0.5987	4.1852	1.4570	1.3320

Source: own elaboration.

Table 4. Johnson SU VaR of the portfolio returns

Quantile	Unhedged portfolio			Hedged portfolio		
	Unadjusted	Volatility adjusted		Unadjusted	Volatility adjusted	
		GARCH	A-GARCH		GARCH	A-GARCH
0.10%	5.88%	6.07%	4.65%	4.95%	4.14%	3.86%
1%	4.10%	4.37%	3.51%	2.86%	2.66%	2.49%
5%	2.82%	3.08%	2.56%	1.63%	1.65%	1.56%
10%	2.21%	2.44%	2.06%	1.14%	1.20%	1.15%

Source: own study.

Based on the results included in Table 4, we can see that VaR levels increased distinctly for the 0.1% quantile. It should be observed that the application of A-GARCH is theoretically the best solution in this case, and in the case of its application VaR levels are generally the smallest. When determining the effectiveness of hedging on the basis of A-GARCH volatility adjusted returns we can say that VaR for a hedged portfolio is smaller with quantiles decreasing by: 0.91, 1.00, 1.03 and 0.79 percentage points, respectively. It leads to a conclusion that delta hedging brought about a decrease in VaR by about 1 percentage point. Percentage VaR can be transformed into the one expressed in value terms by multiplying it by the current portfolio value. In the analyzed case, the last value of the portfolio was PLN 266,251.30, thus, the application of delta hedging diminished 1-day VaR by about PLN 2,662.513. In the case of unadjusted returns or GARCH volatility adjusted returns, VaR estimates for the hedged portfolio differ even to a greater extent from estimates for the unhedged portfolio.

5. Conclusion

Briefly characterized approaches to VaR estimation for option portfolios indicate numerous problems faced by risk managers to be solved. Even in the case of vanilla options portfolio on the same underlying asset, proper estimation of VaR is a difficult task. In the analytical approach, risk mapping considerably simplifies VaR estimates, but the consideration of the implied volatility surface becomes a hard task, if possible to perform at all.

The historical simulation approach has great advantages, yet the size of the sample is a problem. Especially in the case of option portfolios it can pose a serious limitation. In this case also the liquidity of the options market is important, the lack of which may bring about additional problems.

In the presence of the limitations concerning the sample size, Monte Carlo simulation is a good solution. In the case of this simulation it is possible to use a simpler solution in the form of mapping risk factors, but also all significant aspects can be considered, such as the lack of normality of distributions, volatility clustering, asymmetric relationships between risk factors, thus building a very realistic model of the behaviour of risk factors.

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Chapter 4

Managing Exporters' Foreign Exchange Risk Using Vanilla Currency Options[1]

Natalia Iwaszczuk

1. Introduction

In the era of globalization and integration of economies, interest in concepts of risk management continuously grows among theorists and practitioners. This is due to the fact that the enterprises must take into account a number of new operating conditions and solve new problems when it comes to overseas markets. These problems can manifest themselves in the form of new, additional risks. The enterprise should take steps to identify sources of risk and limit its negative impacts. Importantly, the risk should be approached in an active and decisive way. Awareness of the existence of possible threats that are the sources of risks, and their deep research is a prerequisite for active risk management.

Economic risk arises from the making decision that relate to the future. Companies or persons while performing different tasks during their activities, have no guarantee that they will reach the planned results. Risk is not a significant problem if the intended effect will be achieved or get even more. This is the positive side of risk. We have to deal with the negative side of risk if the expected results are not achieved. It follows that if in business the achievement of planned goals is possible, but not guaranteed.

Methods of risk identification are a crucial element in the analysis of this concept. We will not be able to fix all the problems if we do not know all the reasons that lead to them. Similarly, we cannot develop effective tools for risk management if we do not know the factors that cause it.

Risk factors are conditions that affect the probability of incurring losses or making profits, as well as their value. These factors can be divided into external and internal. External factors include factors that relate to economic analysis in a broad sense. Among them are: the level of economic development of a country; the state of financial markets; inflation; political situation in the country; level of international trade; integration with other countries; state of the fuel and energy sector; legal environment of business activities in the country; dependence on international organizations

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etc. Thus, the risk assessment should include evaluation of the impact of the identified risk factors and their categorization and definition of acceptable level of risk for the enterprise.

Currency risk is the risk that threatens entities that have payables and receivables denominated in a foreign currency. This type of risk relates to the increase or decrease in the price of foreign currency. Currency fluctuations can have a significant impact on planning and forecasting cash flows and general profitability of any company. Currency risk affects both importers and exporters of goods and services. However, their currency positions are in reverse. Under certain circumstances, currency risk for some becomes a loss generator, and for others an income generator. Growth rate of the national currency against the foreign currency is unfavorable for exporters. In turn, the depreciation of the currency generates losses for importers who cannot reach previously planned financial results.

Factors related to specific lines of business and industry sector to which it can be counted have a significant impact on the level of risk. Among the sectoral factors deserve special attention: the structure of the industry and the power of competition in it. Instead, the internal factors include microeconomic factors most closely associated with the company. Every company has individual goals. Consequently, the factors that could generate risk should be considered taking into account the organizational structure, i.e. separately at the level of production, logistics, marketing and management.

2. Description of risk management strategies

Awareness of the fact that it is necessary to observe a neutral concept of risk, according to which risk is perceived not only as a threat but also as an opportunity, is critical to modern risk management. In addition, an active attitude towards risk may be a source of profit for the company and can contribute to the growth of its competitiveness.

Because the risk is such as multifaceted phenomenon, it is not surprising that firms create special units that develop risk management strategies (risk policy). These refer to a range of activities aimed at identifying potential sources of risk to the enterprise, reducing the likelihood of its occurrence or mitigate its effects. In this context, significant weight is put on the selection of protective tools, especially in the long term. These instruments include derivatives that are the basis of hedging strategies.

The active management of overall risk, including foreign exchange risk, allows to stabilize the planned effectiveness of economic activity, irrespective of the market situation. Often, the use of complex hedging strategies (based on several derivatives simultaneously) can be a source of significant competitive advantage. Therefore, risk management must include people who know how to investigate and analyze the possibility and likelihood of accidental loss, which may adversely affect the functioning of the company. At the same time, these individuals must develop systems that allow to identify the type of risk and as efficiently as possible (in economic terms) to minimize or eliminate it entirely.

The limitation of risk can be achieved by: transferring it to a third party (financial institution); consciously taking the risk to themselves; insuring themselves against the risk in an insurance company. Moreover, as part of risk management should be developed in one and integrated system management of all kinds of risks that can threaten the enterprise. This integrated risk management system of the enterprise should be based on the process approach, the essence of which lies

in the interpretation of the enterprise as a whole system, consisting of separate interconnected elements and processes. Additionally, one should also consider the relationship between them, which will allow the company to effectively implement its mission and goals.

The need for currency risk management strategies emerged in recent years, due to the significant increase in the amplitude of fluctuations in exchange rates, including the Polish zloty. When in the market is dominated by only one tendency for a long time, companies forget about currency risk, hoping that the existing trend will continue. However, when currency volatility suddenly increases or changes the direction of the trend, companies are beginning to suffer losses due to lack of proper protection. Only then they begin to realize the need of currency hedging strategies. This implies that risk management should cover the whole period of implementation and precede its negative impact.

In this approach, it is important that the different stages must occur in a specific order. The process consists of at least four stages. Each of them consists of a number of operations, without which it is not possible to achieve success measures aimed at eliminating or reducing the impact of risk.

At the first stage, each subject must first ask themselves the task of identifying risk. He should understand what kind of risk can threaten him. Then he should assess how serious the consequences it might cause to its business (estimate of the magnitude of risk) and to identify the main source of potential risk, such as risk of changes in foreign exchange, interest rate risk and price risk or another kind of risk. At this stage, one should determine on which type of risk to focus primary attention, and which ones have minor impact (establishing a hierarchy of risks). This hierarchy is related to the magnitude of potential loss and probability of realization of this type of risk.

In the second step, one should choose how to deal with risk. It means one needs to determine if the main goal is the complete elimination of risk, or perhaps only limiting it. If the organizational structure is quite built up, it is possible to divide the risk by segments or certain types of the subject's activities. The hardest part of this stage is the transfer of risk, including external instruments and participation of financial intermediaries.

The third step is the financing of risk. At this stage the company must choose the path between self-insurance and insurance in foreign companies. If it has enough money, the use of self-insurance method is more secure, but its effectiveness may be insufficient. External insurance will require more resources and the signing of binding contracts, which in turn will generate additional costs and risks (for example, the failure of the insurance company and its obligations).

The fourth stage is the control of risk, i.e. the efficiency of verification methods used. One should continue to hold the chosen strategy of risk management, if there are positive effects. And one should seek other alternative risk management techniques if the results differ from the expected effects on the negative side.

In summary, it should be noted that in the traditional method of construction of protective strategies the different stages must occur in a specific order and each of them must be carefully implemented so as not to increase the possible error. It follows that the full implementation of the traditional method requires a long time horizon. In addition, negligence or lack of precision in any of the stages can increase errors in subsequent stages. This means that a risk management process requires precision, reliability, and analysis of the full data set. Its built up structure requires a long period of implementation. Finally, management of the traditional methods can generate high opportunity cost, i.e. the loss of potential positive opportunities for the company.

Existing risk management methods differ one from another in degrees of difficulty. In practice: complexity of risk management should be commensurate with the level of risk that threaten

the enterprise. Although the basic elements of risk management are systems and reports, but only effective communication and understanding of each type of risk is the essence of integrated risk management program.

Contemporary risk management strategies are based on methods that use derivatives. There are a set of tools on the market. Among them we can choose those that are best suited for this type of risk, and this type of activity.

These tools can be used simultaneously or independently of each other. The use of one of them does not preclude the use of another. An important advantage of these methods of risk management is a relatively short time of building a strategy and rather high mobility and liquidity of the instruments used.

In methods of the currency risk hedging that are based on derivatives, one should pay attention to: forward contracts and futures contracts, swaps, standard options and some types of exotic options, such as, for example, barrier options, spread options, quanto options, beach options or flexo options.

Swaps have become very popular among hedging tools in recent decades. The currency swap agreement (or contract of exchange rates) allows to exchange a certain amount of one currency for another at some point in time (a certain date), and then re-exchange those currencies (or vice versa), to another time (for example six months). The purpose of the swap is to move from one currency to another, over a period of time, so that later return to the original currency. However, the swap is a tool of OTC market which liquidity is quite low. The exchange market tools are more popular among hedgers and speculators.

Futures and options are the main derivative tools that are traded on exchanges. Futures contracts are formalized and standardized by the size and time of delivery of underlying assets. Contracts of this type are available in different currencies with different lifetimes (from 1 week to 1 year). They are relatively inexpensive for the clients (the price is about 0.1% of the transaction).

A currency option is a contract that gives the buyer the right to buy or to sell a certain type of currency at a specified price on a future date and in certain quantities. A currency option is more flexible and favorable hedging tool than described above derivative tools. Most clients come to this tool in times of significant uncertainty and volatility in the foreign exchange market.

A buyer of the option has the right (but not the obligation) to buy (call option) or sell (put option) a specific amount of currency at a pre-agreed time and at an agreed price, and a seller must fulfill the contract at the request of its owner. The decision on whether an investor buys a call option or a put option, depends on whether it expects growth or decay rate of a particular currency. Equally important is also the currency in which the account is performed. Currently, the most popular in the world unit of account is the American Dollar, in second place – the euro, and behind them – the Japanese Yen. This order is related to the number and value of transactions carried out by the countries to which these currencies belong. In addition, confidence in the dollar remains from the time when it played the role of a world currency.

Returning to currency option contracts, the special role of a seller should be emphasized, who is the passive side in the exercise of the contract. This means that when a buyer of the call option will require the execution of an option contract (on a predetermined date), a seller will be obligated to deliver and sell a certain amount of currency at a fixed rate. In turn, a put option gives a buyer the right to sell a certain amount of currency at a predetermined rate and a seller of the option is obliged to buy it.

The payment of option premium (as payment for acquired right) not carried out in parallel with the execution of the option contract. It must be ahead of this time. First, it follows from the nature of the option, which has a delayed lifetime (like other derivatives). Second, the option can be carried out, but it is not required. It depends on its payoff functions and current market conditions (in the case of a currency option – the exchange rate on the spot currency market and the free-risk interest rate).

Derivatives (mainly forward contracts and futures) were formerly used only in commodity markets. Financial variants began to appear much later. Regarding options, which are the subject of this research study, a broader interest to them appeared only in the 70s in the twentieth century. The publication of several works devoted to options issued on shares (Black & Scholes, 1973; Merton, 1973, 1976) and the introduction of their trading on the American stock market contributed to this. Therefore, derivatives have become the focus of many financial institutions, which used them effectively for both speculation and protection. In further research, scientists focused on extending the list of underlying assets for derivatives. As a result, there appeared derivatives based on interest rates, stock indices and exchange rates (Grabbe, 1983; Hull & White, 1987; Hull, 2000).

However, despite the existence of such a large selection of derivatives, they were not used often in business practice. Businesses from the USA were the leaders in this regard. In Poland, more interest in options appeared at the beginning of the XXI century. Unfortunately, the crisis of 2008 and the turmoil on the domestic market around FX options resulted in loss of confidence in them. The following example is an attempt to prove that proper selection of an option's parameters can make it an effective instrument in managing foreign exchange risk.

3. Examples of management strategy based on standard options

Companies can start researching tools and methods that will protect them from serious financial consequences of its actions only after properly conducted risk identification caused by exchange rate volatility.

To illustrate the impact of currency risk we chose a company X that exports goods abroad. Research on company for a certain period of time showed that its average turnover of export goods was about 180,000 kg, and the average export price was 15 €/kg at that time. Therefore, the monthly export value can be estimated by the amount of 2,700,000 €.

The average foreign exchange rate in the study period was 4.35 PLN/€. This means that the value of exports in terms of domestic currency was 11,745,000 PLN. Exporters had to exchange foreign currency for the national one, as they must pay for their liabilities in their own country. These commitments include taxes, land rent, staff salaries, etc.

According to the National Bank of Poland, the volatility of the PLN to the EUR in the same period was 4.8%. This means that the exchange rate may fall to the level of 4.14 PLN/€, but can also increase to 4.56 PLN/€. In the latter case, the company will receive additional financial benefits, so it will be ignored in this article, which deals with the negative impact of the foreign exchange risk. We will consider only the case of a decrease in the EUR/PLN exchange rate.

If we examine the long-term prospects for our company, then exchange rate volatility should be considered for a longer period. Currency volatility can even reach 10% in the long-term. In terms of exchange rate, it gives us a range of changes from 3.92 to 4.78 PLN/€. Higher volatility of the exchange rate can lead to much more serious financial implications for the exporter.

Therefore we cannot exclude also the most pessimistic script for him, as history knows many examples of financial crises.

For exporter devaluation of contract currency is an additional factor that may affect the amount of possible losses. If we assume that exchange rate will fall to 4.30 PLN/€, then the company can lose on the contract 135,000 PLN. With the fall of the exchange rate to 4.20 PLN/€, the loss amount will be 405,000 PLN. Further depreciation, such as 4.14 PLN/€ or 4.08 PLN/€ will bring the exporter even greater losses: 567,000 PLN or 729,000 PLN, respectively. Instead, the sharp depreciation to the level of 3.92 PLN/€ can bring monthly loss about 1,161,000 PLN.

So only depending on the value of the EUR exchange rate to PLN, the potential loss to company X ranges from 135,000 to 1,161,000 PLN. Risk of reduction in the price of exported goods, for example, can also be added to this risk.

The most extensive group of protective instruments are options whose price depends on the probability of earning income. An option contract is an agreement between a buyer and a writer (issuer of option) that gives a buyer the right to buy from (or sell to) an issuer of a certain number of underlying assets (tools) at a predefined price and for a specified period of time. The base (underlying or primary) tool can be valuable paper (stocks, bonds), stock index, currency, interest rate, commodity, etc. In exchange for the acquired right, the buyer of an option pays the price of an option, which is called the option premium. Predetermined selling price of the option is called the strike price (or exercise price).

Standard (or vanilla) options are divided into so-called European and American. And each of them may be an option for purchase (call option) or an option of selling (put option). Options relatively rarely continue until the expiry date. Often they are exercised or liquidated before its onset, indicating that the derivatives have high liquidity. An additional advantage of these derivatives is that they are traded on the stock exchanges as well as on OTC.

Options deserve special attention because they have very high flexibility in creating hedging strategies (Węgrzyn, 2009). For example on the Warsaw Stock Exchange traded options with four expiry dates. There are many available series of call options and put options with different strike prices within each period. This variety of tools makes it possible to create different hedging strategies, depending on the needs of hedgers. When using options, you can create strategies that protect an enterprise at different scenarios of market changes. You can also diversify the costs of hedging strategies, and the value of potential compensation.

In this article we will focus on the standard European options, which give a buyer the right to buy or to sell a certain type of currency at a fixed price (exchange rate) at a specific future date and in the agreed amount. Currency options are increasingly being used to hedge risk of transactions if the company wants to fix the exchange rate at a certain level, and at the same time wants to keep the possible benefit of a favorable change of the exchange rate.

Currency derivatives can be used in hedging strategies of large, small and medium enterprises, financial institutions and individual investors. However, they all face the problem of verification fair option premium. Scientists are trying to create time-efficient evaluation models of these derivatives. One of such models is the model for evaluating standard currency options developed by M. B. Garman and S.W. Kohlhagen based on the world famous Black-Scholes model (Black & Scholes, 1973). Therefore, the assumptions used in the model are similar to the assumptions of the Black-Scholes model. According to the Garman-Kohlhagen (1983) formula for calculating the European currency option price with the right to buy currency takes the form (Weron & Weron, 1983, p. 199).

$$C = S_0 e^{-r_f T} N(d_1) - K e^{-r_d T} N(d_2) \tag{1}$$

$$d = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r_d - r_f + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} \tag{2}$$

$$d_2 = d_1 - \sigma\sqrt{T} \tag{3}$$

where:
S_0 – the current exchange rate on the spot market (at the time of calculation of the option price),
K – the rate of exercise (the strike rate),
T – the time to maturity of the option,
r_f – foreign risk free interest rate,
r_d – domestic risk free interest rate,
σ – the volatility of the foreign exchange rate,
$N(d_i)$ – the distributive of the standardized normal distribution for the random variable $d_i, i = 1, 2$.

By analogy, we can write the formula for calculating the price of a standard European option with the right to sell foreign currency:

$$P = K e^{-r_d T} N(-d_2) - S_0 e^{-r_f T} N(-d_1) \tag{4}$$

Such a currency option (namely a put option) can be regarded by Company X as one of the possible tools on which will be based protection from exchange rate depreciation of EUR to PLN. Its pricing model excludes the actual implementation with a low strike price and with long enough lifetime. The option with the highest strike price and the shortest lifetime will require from exporter the highest financial cost to build the hedging strategy. This follows from the formulas of evaluation of an option due to two reasons:

1. the exercise of this option will bring the greatest benefit to the exporter and the biggest losses to the option issuer,
2. if the current exchange rate (spot market) is much lower than the rate of exercise, its sudden growth in the short period (which would be useful for the option issuer) is unlikely.

Payment (pay-off) function is a mathematical expression to calculate the amount that the owner of an option (e.g. put option) would make if he bought currency at a lower rate on the spot market and resold it to the issuer at a strike price.

In the example, the exporter wants to secure a sum of 2,700,000 €, which he will receive in the future (in 1, 2, 3 and 6 months) for the delivery of goods (here 180,000 kg of exported goods for 15 €/kg). The model used the following values for foreign risk free interest rates: for 1 month it is 0.03%; for two months it is 0.06%; for 3 and 6 months it is 0.09%. Volatility of the exchange rate is 4.8%. In contrast, the domestic risk free interest rates for different terms are as follows: for 1 month it is 1.56%; for two months it is 1.62%; for three months it is 1.67%; for 6 months it is 1.74%. These values were determined on the basis of statistical data from the appropriate periods of time. Table 1 shows the results of estimating the price of put options issued on 2,700,000 € at three different exercise prices of options. Exercise prices (4.29 PLN/€, 4.31 PLN/€ and 4.33 PLN/€) were chosen close to the average exchange rate (4.35 PLN/€) in the period preceding the conclu-

sion of the option contract. This will allow the comparison of different hedging strategies from the point of view of cost and performance.

Calculating a cost per option contract for our exporter, we notice a large variation in the values of stock option premium (from 0 to 68,177.70 PLN). This variation decreases with increasing time left to realization of an option as increasing the likelihood of changes in exchange rates on the spot market and their value.

Table 1. Results of option hedging total cost calculations

Lifetime [months]	**Strike rate**		
	4.29 PLN/€	**4.31 PLN/€**	**4.33 PLN/€**
	Total cost	**Total cost**	**Total cost**
1	0 PLN	7,583 PLN	32,628 PLN
2	7,654 PLN	29,966 PLN	53,583 PLN
3	23,947 PLN	46,062 PLN	68,177 PLN
6	0 PLN	15,613 PLN	58,515 PLN

Source: own elaboration.

On the other hand, Table 2 compares the effectiveness of the proposed strategy (at the following exercise prices: 4.29 PLN/€, 4.31 PLN/€ and 4.33 PLN/€) in four cases of the formation of an unfavorable exchange rate on the spot market (4.20 PLN/€, 4.14 PLN/€, 4.081 PLN/€ and 3.92 PLN/€). They were examined in this article at the beginning of this point.

Table 2. The financial results achieved by the use of option hedging, compared to an unsecured position

Time [months]	**Exchange rate on the spot market**			
	4.20 PLN/€	4.14 PLN/€	4.08 PLN/€	3.92 PLN/€
	Financial result	Financial result	Financial result	Financial result
Strike rate 4.29 PLN /€				
1	405,000 PLN	567,000 PLN	729,000 PLN	1,161,000 PLN
2	397,346 PLN	559,346 PLN	721,346 PLN	1,153,346 PLN
3	381,053 PLN	552,053 PLN	705,053 PLN	1,137,053 PLN
6	405,000 PLN	567,000 PLN	729,000 PLN	1,161,000 PLN
Strike rate 4.31 PLN /€				
1	397,417 PLN	559,417 PLN	721,417 PLN	1,153,417 PLN
2	375,034 PLN	537,034 PLN	699,034 PLN	1,131,034 PLN
3	358,938 PLN	520,938 PLN	682,938 PLN	1,114,938 PLN
6	389,387 PLN	551,387 PLN	713,387 PLN	1,145,387 PLN
Strike rate 4.33 PLN /€				
1	372,372 PLN	534,372 PLN	696,372 PLN	1,128,372 PLN
2	351,417 PLN	513,417 PLN	675,417 PLN	1,107,417 PLN
3	336,823 PLN	498,823 PLN	660,823 PLN	1,092,823 PLN
6	346,485 PLN	508,485 PLN	670,485 PLN	1,102,485 PLN

Source: own elaboration.

Also, one should pay attention to the fact that Company X will not find a partner to build an option strategy at a strike rate of 4.29 PLN/€ (for a period of 1 or 6 months), because the zero value of the option premium does not satisfy any of them (Tab. 1). A similar situation is with strike rate below 4.29 PLN/€. It is doubtful that there is a buyer who will decide to take the risk of exchange rate for Company X.

Positive values of financial result in Table 2 indicate a positive result of the application of the proposed strategy, compared to the unsecured position (considered at the beginning of point 3). However, the example above includes only a few selected development paths in the currency market. They are not exhaustive of all possible variants. Therefore, Company X should carry out a more detailed and comprehensive study (which would not fit in one article) to select the best way to protect their market position against currency risk. In the example above, transactional costs were not included, which slightly reduce the effectiveness of the proposed strategy. They will be the subject of further research.

When building a strategy based on options (Węgrzyn, 2012) important is the choice of methods for identification and assessing levels of volatility of the underlying instruments. Besides, you should take into account the interest rate (domestic and/or foreign) for the relevant period and the transaction costs associated with the conclusion of the option contract (Węgrzyn, 2015).

Thus, we conclude that the ideal solution to the problem of this currency risk is virtually nonexistent. But we cannot give up active management, because once can choose other options suggested here or use other types of this derivatives (e.g. exotic options).

4. Conclusion

Analysis of the proposed option strategies leads to the conclusion that their use is more profitable for a company than remaining in a neutral position, which does not provide any protection from currency risk. The economic success of these strategies depends on the due date of the transaction, the number of exported or imported goods, their price, as well as many independent (so-called market) parameters such as the current price of the product, its variability, bank interest rates on loans, etc. Positive financial performance is a measure of this success.

As long as the international exchange of goods and services exists, the problem of currency risk remains relevant and we have to seek protection from it. But we must not forget that options are not a solution that ensures the success of each project. Their use is also associated with some risk, which is not the same risk from which they defend (in our case – currency risk). This risk is measured by the degree of sensitivity of the option to changes in internal and external factors. Sensitivity of options can be defined on the basis of so-called "Greek" coefficients.

However, when using options as hedging instruments, one should remember about the possibility of choosing a long position in an option contract. A long position means acquiring rights (without any obligation) to buy/sell (call/put option) the underlying asset. In contrast, the short position is betting on the sale of an option to obtain an option premium and all obligations derived from it. Thus, only the long position is characterized by a limited risk (the sum of option premiums) and only it is suitable for building a structure of hedging strategies.

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Chapter 5

Risks of Capital Investments in Coal-fired Power Plants and Alternatives

Marek Michalski

1. Introduction

There are many risks associated with capital investments in constructing coal-fired power plants, such as: the risk of technological progress in this type of plants or alternative generating technologies that changes both the competitiveness and the environmental impact relative to other types of power plants; fuel price fluctuations and regulatory changes, mainly with respect to environmental protection and climate change. The last aspect is especially difficult to forecast and manage. The goal of this chapter is to assess the risks of capital investments in coal-fired power plants and present alternatives to this type of generation.

Coal-fired power plants have the highest capital investment costs per unit generating capacity among fossil fuels. Given significant economies of scale, they tend to be large, often comprised of multiple generating units with the option of adding new ones at a later time, if needed. Due to these factors, investments in coal-fired power plants are capital intensive and they have long payback periods. This makes decisions to build one, usually costing hundreds of millions and sometimes billions of euros with projected payback periods usually exceeding 20 years, very risky.

A primary consideration is the option of choosing alternative energy sources. Constructing nuclear power plants is even more capital intensive but fuel is cheaper and there is no air pollution nor greenhouse gas emissions. Natural gas fueled power plants are less expensive to build but fuel costs more. The comparison to renewable energy sources is more nuanced as capacity factors tend to be lower for so-called "green" power plants since they usually do not operate at nominal capacity as the water flow, wind speed, amount of sunshine etc. are often much less than optimal with capacity factors usually well below 50%. An exception to this is geothermal power that can usually operate continuously at close to nominal capacity. However, its use in power generation is limited to high-temperature sources[1]. The comparison of coal to renewables is even more dif-

[1] It is technologically possible to generate power from relatively low-temperature geothermal sources, even at less than 100 degrees Celsius, but this is usually uneconomical, except in remote locations without access to the grid and other energy sources.

ficult in terms of valuing the relatively large, continuous and reliable output of coal-fired plants versus the lower environmental impact of renewables-based generation.

There are also alternative uses for coal to be considered such as its use in the chemical industry and coal liquefaction (Yan et al., 2014). On a national scale, given concerns about the intermittency of solar and wind power, and in the absence of favorable hydrological conditions for building large-scale hydropower plants, nuclear power plants are often viewed as a vast and reliable source of electricity (Jędrysek, 2015).

Before going into more details of the risks of capital investments in coal-fired plants, it is necessary to evaluate coal supply risk and conditions as well as coal price and capital cost risk.

2. Coal supply risk and conditions

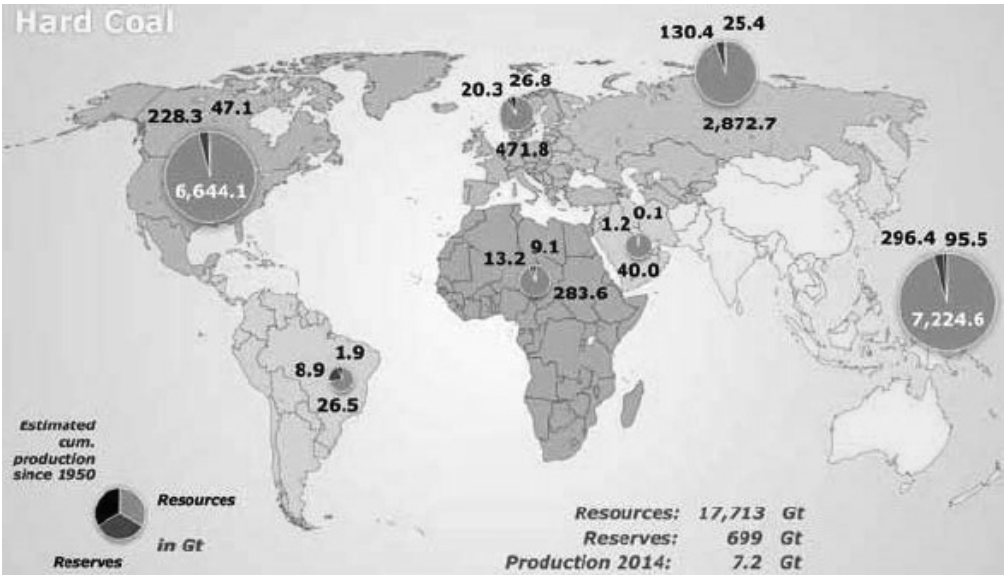
Despite significant pressure to increase the share of renewable energy sources, fossil fuels remain the main source of energy in the world and even in rich countries that strongly promote renewables, such as Germany. In power generation, coal is the most commonly used fossil fuel in the world.

Coal is divided primarily based on its heating value into hard coal and brown coal, also called lignite[2]. In general, brown coal tends to be less expensive since it is mined in open-pit mines but a larger volume is required due to its lower heating value. This also usually makes long-range transport of brown coal uneconomical. Furthermore, coal moisture, ash and pollutant content, such as mercury levels, determine processing as well as emission reduction costs and technological requirements. Hard coal has a higher heating value but its extraction usually requires underground mining which is more expansive than open-pit mining.

Coal supplies are by far the most abundant among fossil fuels. At current production rates, world hard coal reserves, the portion of proven resources that are economically exploitable at current prices and using existing technology, would last for 97 years. Hard coal resources are sufficient to last over 2000 years at today's production rates. For lignite, the time periods are 286 and over 4000 years respectively. Thus existing coal reserves and resources offer abundant supply for the foreseeable future. They are also widely distributed. Despite the disproportion in reserves and resource distribution shown in Figures 1 and 2, there is still sufficient supply to meet consumption needs in all regions. Furthermore, the large supply also provides almost unlimited import opportunities from various parts of the world. However, as discussed previously, long-range transport and thus also the import of lignite is usually uneconomical given its low heating value both per unit volume and mass. Figure 1 shows the distribution of word hard coal resources in billions of metric tons.

[2] The term *lignite* is sometimes used to refer to low heating value brown coal but there is no internationally agreed on way of differentiating between brown coal and lignite.

Figure 1. World hard coal resources

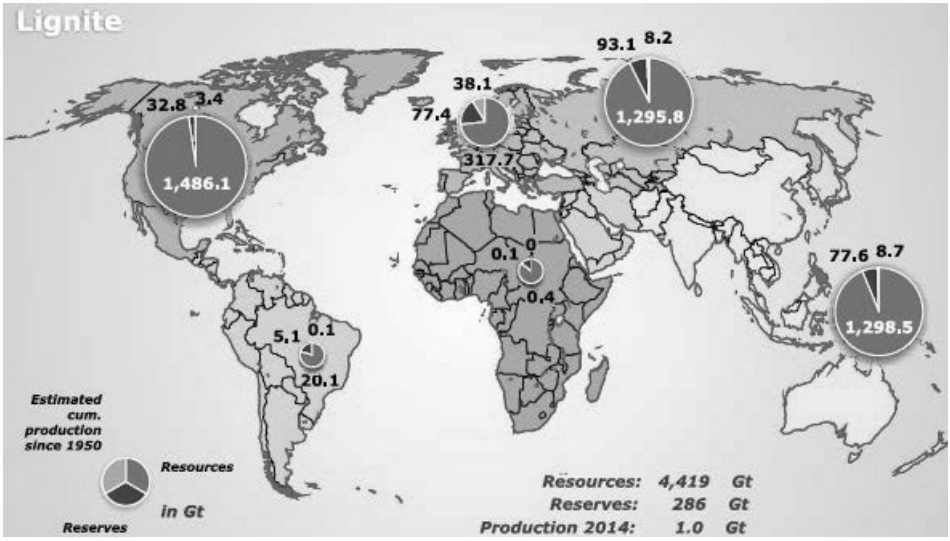


Note: Gt = gigatonne = 1 billion metric tons

Source: (Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), 2015, p. 44).

Figure 2 shows the distribution of word lignite resources in billions of metric tons. Per unit mass they are equal to about a quarter world hard coal resources. The portion is even smaller in terms of energy content, although the precise proportion is difficult to estimate given the large variations in heating values between deposits and even between different layers of the same deposits. In general, the deeper the deposits, the more difficult and costly they are too extract, but their heating value also increases.

Figure 2. World lignite resources

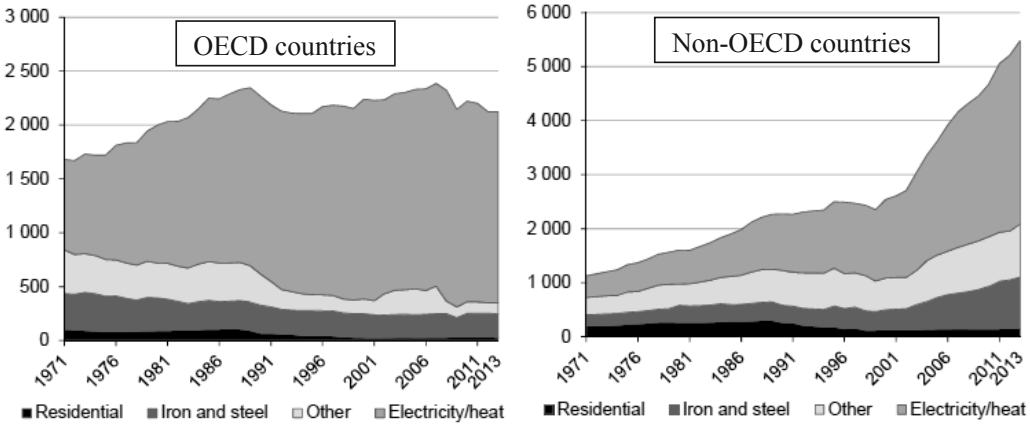


Note: Gt = gigatonne = 1 billion metric tons

Source: (Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), 2015, p. 47).

The vast majority of coal production, 68% in 2013, is used for electricity and heat production. As shown in Figure 3, the share is much higher in OECD countries accounting for about 83.5%, whereas in non-OECD countries it is 62%. Nevertheless, due to the much higher share of non-OECD countries in world coal consumption, their use patterns have a much larger impact on overall world consumption shares.

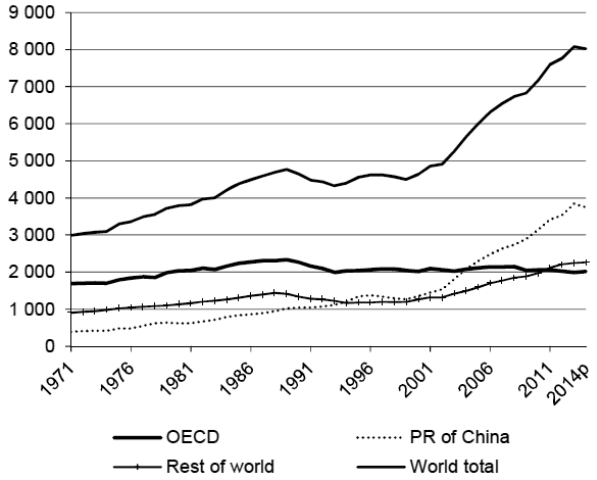
Figure 3. Primary coal uses in OECD and non-OECD countries in 1971-2013 [Mt]



Source: (International Energy Agency (IEA), 2015a, p. II.19).

As shown in Figure 4, despite leveling off in OECD countries, coal production continues to increase in the rest of the world.

Figure 4. World coal production 1971-2014 [Mt]



Note: Mt = megatonne = 1 million metric tons

Source: (International Energy Agency (IEA), 2015a, p. II.3).

China is both the world's largest consumer and producer of coal. Given the scattering of resources shown in Figures 1 and 2, this still does not give China the power to limit supply but its large share of world coal consumption (65% in 2013) gives it a strong influence on price.

Overall, coal supply risk is low but price risk requires more analysis.

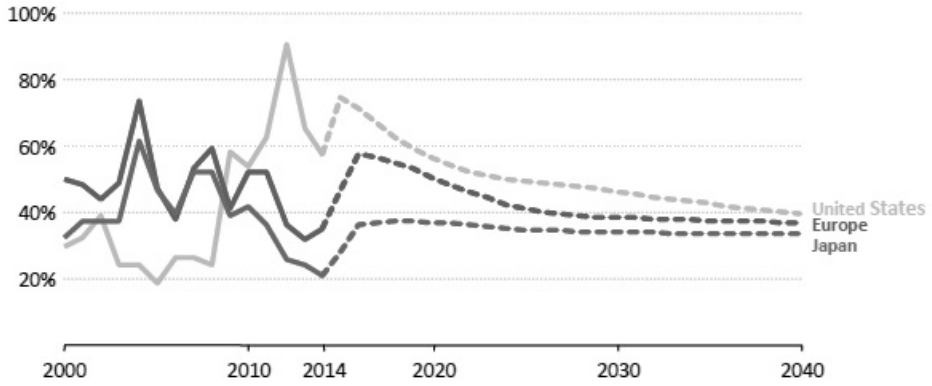
3. Coal price risk

Coal prices are generally set by the market, taking into account transportation costs. However, many large coal producers are struggling. For example, the Czech coal group OKD, which is Eastern Europe's largest private coal miner, is currently preparing for bankruptcy (Foy, 2016). Thus to compare coal with other fuels pricing methodologies are being developed for calculating an economically justifiable price, such as the approach to brown coal pricing using internal rate of return developed by Bejbl and others (2014) in which the price of a commodity is set in a way that assures an adequate return.

Coal prices should be considered in relation to other fuel costs. Among fossil fuels, natural gas is usually viewed as a substitute since oil is much more expensive for electricity production[3]. A comparison of historic coal prices relative to gas prices per unit of energy since 2000 is shown in Figure 5. Based on International Energy Agency (IEA)'s forecast coal prices are expected to converge to about 40% of the gas price per unit of energy.

[3] Oil's ease of use in relatively inexpensive and portable generators still make it popular as a fuel for generating electricity but this is mostly limited to remote locations or intermittent use such as backup power sources.

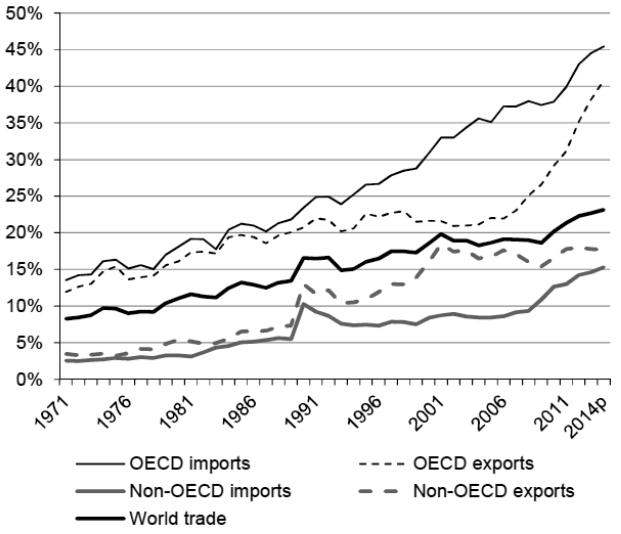
Figure 5. IEA's forecast coal price relative to gas price per unit of energy



Source: (International Energy Agency (IEA), 2015b, p. 52).

The narrowing of price gaps between the major world markets may be attribute to increasing coal trade as a percentage of consumption as shown in Figure 6.

Figure 6. Steam and coking coal trade as a percentage of consumption



Note: percentages are based on energy, not mass.

Source: (International Energy Agency (IEA), 2015a, p. II.7).

Given the ample and widely distributed supply discussed in section 2 of this article and the increasing international trade in all markets shown in Figure 6, coal price risk is expected to be low with price differences attributable to transportation costs and taxes. The next issue to consider is capital cost risk.

4. Capital cost risk

The expected lifetime of a coal-fired power plant is estimated at 40 years, which is longer than for wind and solar (25 years) as well as natural gas (30 years) but shorter than nuclear power (60 years) and hydropower (80 years). Based on a recent survey of 14 coal-fueled plants, the so-called *overnight cost* for building one in OECD countries ranged from 1218 USD/kWe for a plant built in South Korea to 3067 USD/kWe for one built in Portugal. The mean cost of these plants was 2080 USD/kWe and the median was 2264 USD/kWe (IEA et al., pp. 16, 30, 37). A comparison of minimum, maximum, mean and median construction costs for various power generation technologies based on a large survey is given in Table 1.

Table 1. Comparison of median power plant construction costs as percentage of coal

Technology	Construction cost (USD/kWe)				
	Min	Max	Mean	Median	Median as % of coal
Natural gas – CCGT	627	1289	1021	1014	45
Natural gas – OCGT	500	933	708	699	31
Coal	813	3067	2080	2264	100
Nuclear	1807	6217	4480	5026	222
Solar PV – residential	1867	3366	2371	2307	102
Solar PV – commercial	728	1977	1583	1696	75
Solar PV – large	937	2563	1562	1436	63
Solar thermal (CSP)	3571	8142	5964	6072	268
Onshore wind	1200	2999	1940	1841	81
Offshore wind	3703	5933	4985	4998	221
Hydro – small	1369	9400	5127	5281	233
Hydro – large	598	8687	3492	2493	110
Geothermal	1493	6625	4898	5823	257
Biomass and biogas	587	8667	4447	4060	179
CHP (all types)	926	15988	4526	2926	129

Source: (IEA et al., 2015, p. 37) and own calculations.

The actual construction cost for coal-fired power plants depends on multiple factors, mostly on:

- size,
- efficiency,
- fuel type and quality,
- emission reduction technologies,
- capital cost,
- land and labor costs, and
- regulatory requirements.

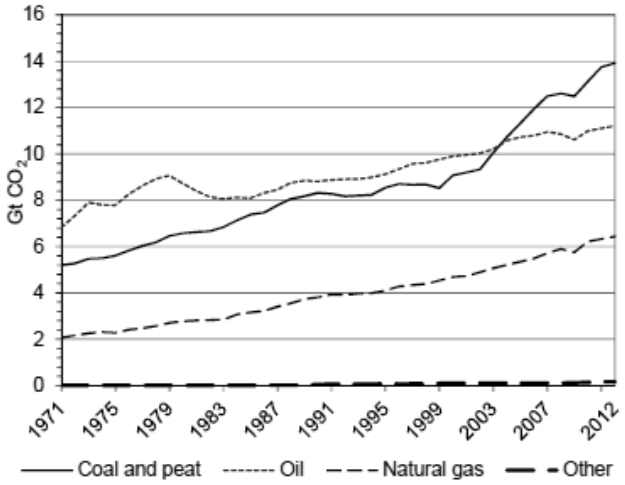
Increasing efficiency requires raising temperatures and pressures which is cost intensive. The actual technologies to be used at a given location are chosen based on relative effectiveness and cost as well as existing and planned environmental protection laws and associated financial incentives or penalties. In recent years, investors' concerns about long payback periods have been exacerbated by uncertainty on environmental regulation.

5. Environmental risk

While literature usually assumes that technological progress reduces marginal price, Mekaroonreung and Johnson (2014) show that recently the opposite occurs as more stringent environmental regulations increase the capital cost of building coal-fired power plants. This may be expected to continue as new regulations keep reducing acceptable levels of harmful emissions such as NO_X, SO_2 and particulate matter – usually measured in the PM2.5 and PM10 scale.

There is growing global debate and concern over the effect of greenhouse gas emissions on global warming. Even though CO_2 is estimated to account for no more than 25% of the greenhouse effect, which is far less than water vapor that accounts for up to 70% (Kiehl et al., 1997; *Water Vapour: Feedback or Forcing?*, 2005), the focus of initiatives such as the European Trading System (ETS) and the 2015 United Nations Climate Change Conference, also known as the Conference of the Parties (COP) 21, which is a follow up on the 1992 United Nations Framework Convention on Climate Change (UNFCCC), is to limit man-made carbon dioxide emissions. So far, despite increasing energy efficiency and decreasing energy intensity[4] in highly developed countries[5], economic progress in developing countries keeps increasing worldwide fuel use. As shown in Figure 7, coal and peat have recently surpassed oil as the main source of CO_2 emissions from burning fuels.

Figure 7. World CO_2 emissions by fuel



Source: (International Energy Agency (IEA), 2015a, p. II.21).

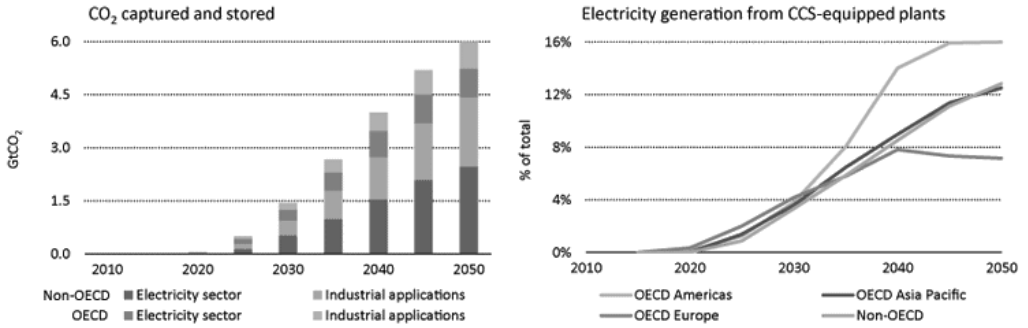
Thus there is much research into limiting these emissions. Given the high cost of increasing efficiency, recently the focus has been on carbon capture and storage (CCS) which is a process and technology for separating and capturing CO_2 from large emission sources, such as power plants, and storing it underground.

[4] Energy intensity is defined as the amount of energy per unit of gross domestic product (GDP) in the economy of a country.

[5] Highly-developed as measured using the United Nations (UN) Human Development Index (HDI).

The goal is to store it underground or underwater indefinitely but there are concerns that over long-term leakage back into the atmosphere (Phelps et al., 2015). Nevertheless, pilot CCS plants are being build and there are plans for industrial-scale installations as shown in Figure 8. Yet wide-scale adoption is expected to take a long time as CCS-equipped plants are expected to account for less than 20% of generation until 2050.

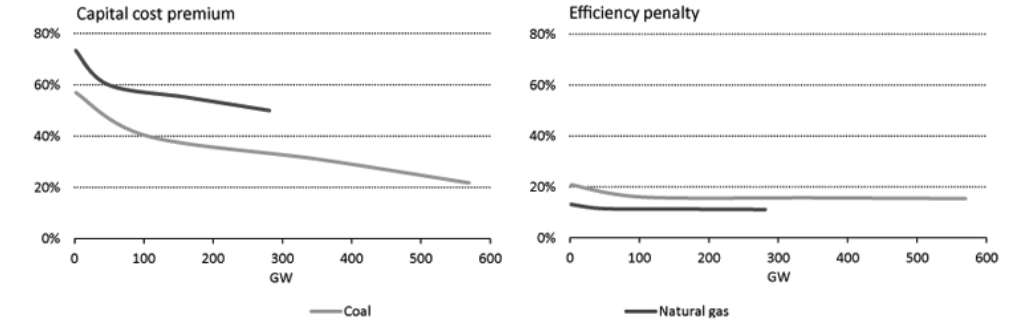
Figure 8. Forecast of CCS use and electricity generation from CCS-equipped plants until 2050



Source: *(Energy Technology Perspectives 2015)*.

The main obstacle to wide-scape adoption is lack time-proven industrial-scale technology and the significant cost of implementing CCS as shown in Figure 9 that is expected to increase capital costs by 50-75% and reduce efficiency by about 10%.

Figure 9. Impact of adding CCS on plant cost and efficiency for coal and natural gas



Note: GW = gigawatt

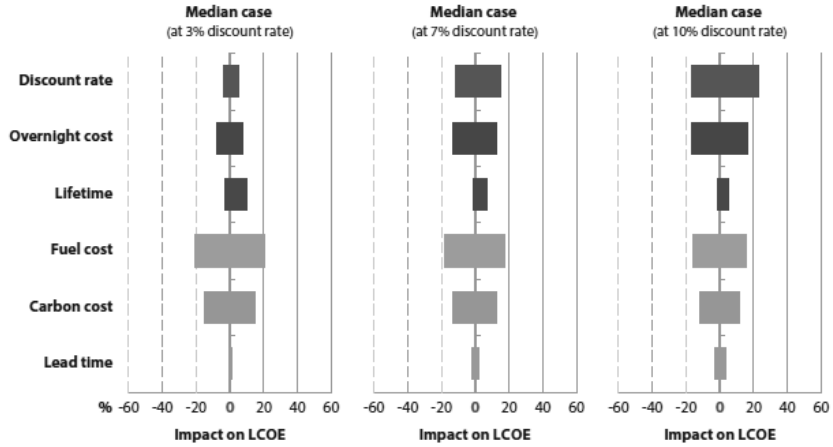
Source: *(Energy Technology Perspectives 2015).*

The capital cost premium is high and exacerbated by the penalty in efficiency that reduces net energy output. Nevertheless, given that this is a developing technology, there is scope for technological breakthroughs that will make CCS more economical.

6. Coal generation costs risk

The impact on the levelized cost of electricity (LCOE) of the main risk factors for coal-fueled generation costs are shown in Figure 10. Six factors have been identified: discount rate, overnight (construction) cost, lifetime, fuel cost, carbon (emissions) cost and lead time.

Figure 10. Risk factors for coal generation costs



Source: (International Energy Agency (IEA) 2015b, p. 119).

The risk associated with the overnight cost and lead time increase as the discount rate increases, whereas the lifetime and fuel cost risk decrease with an increasing discount rate. Depending on the discount rate, discount rate and the fuel cost changes are the highest risk factors. Overnight construction cost and carbon emissions costs are significant concerns for all discount rates. The lifetime and lead time have the relatively lowest impact on generation costs.

There is very limited scope for mitigating these risks since all, except the lead time and to some degree the lifetime, are external conditions that cannot be controlled by the investor.

7. Conclusion

The analysis presented in the article led to the following conclusions regarding the risks of capital investments in coal-fired power plants and alternatives:

1. There are numerous risks associated with capital investments in constructing coal-fired power plants, such as: the risk of technological progress in this type of plants or alternative generating technologies that changes both the competitiveness as well as the environmental impact relative to other types of power plants; fuel price fluctuations and regulatory changes, mainly with respect to environmental protection and climate change. The last aspect is especially difficult to forecast and manage.
2. Investments in coal-fired power plants are capital intensive and they have long payback periods. This makes decisions to build one very risky.

3. A primary consideration is the option of choosing alternative energy sources. Constructing nuclear power plants is even more capital intensive but fuel is cheaper and there is no air pollution nor greenhouse gas emissions. Natural gas fueled power plants are less expensive to build but fuel costs more. The comparison to renewable energy sources is more nuanced as capacity factors tend to be lower for so-called "green" power plants since they usually do not operate at nominal capacity. An exception to this is geothermal power.
4. There are also alternative uses for coal to be considered such as its use in the chemical industry and coal liquefaction. In the absence of favorable hydrological conditions for building large-scale hydropower plants, nuclear power plants are often viewed as a vast and reliable source of electricity.
5. Given ample and widely distributed supply and the increasing international trade in all markets, coal price risk is expected to be low with price differences attributable to transportation costs and taxes.
6. In recent years, investors' concerns about long payback periods have been much exacerbated by uncertainty on environmental regulation.
7. The main obstacle to wide-scape adoption of carbon capture and storage (CCS) is a lack time-proven industrial-scale technology and the significant cost of implementing it that is expected to increase capital costs by 50-75% and reduce efficiency by about 10% for coal.
8. The risk associated with the overnight cost and lead time increase as the discount rate increases, whereas the lifetime and fuel cost risk decrease with an increasing discount rate. Depending on the discount rate, discount rate and the fuel cost changes are the highest risk factors. Overnight cost and carbon emissions costs are significant concerns for all discount rates. The lifetime and lead time have the relatively lowest impact on generation costs.
9. There is very limited scope for mitigating these risks since all, except the lead time and to some degree the lifetime, are external conditions that cannot be controlled by an investor.

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Chapter 6

System-based Risk Management in Business Activity – Methods of Review

Jacek Pera

1. Introduction

The issue of risk and uncertainty gains significance in the circumstances of the enterprise's market environment's high level of variability. That is why the issue of risk management occupies an increasingly important place in the strategy of its growth.

Business activity's inherent feature is the constant necessity of making choices. Depending on the conditions, decision-making can have different levels of difficulty. The basis of decisions made in deterministic conditions is the differences between insecurity and risk.

The issue of system-based risk management is becoming the focus of attention of many organisations. The problem is not the risk itself, but the way the organisation deals with it. The aim of system-based risk management is not reduction or elimination of risk, but the strategic way of counteracting its destructive effects in the variable market reality.

The aim of this paper is an overview of solutions for risk analysis systems based on of the literature review. The methods of choice is based on the frequency of their use in business practice.

2. Insecurity and risk of business activity in literature

Risk and insecurity are perceived in a range of different ways. Their definitions, evolving with the development of science, are still used interchangeably. In order to discriminate between the two concepts, we have to note the objective and measurable character of risk versus subjective and immeasurable character of insecurity.

The differences between risk and insecurity result from the information one has, from previous practices and the influence on the quality of decisions made (Gostkowska-Drzewicka, 1999). In literature, insecurity is understood in a broader sense than risk, which is insecurity's derivative. Risk, as opposed to insecurity, is characterised with being able to be identified and measured in advance, as well as to be managed, all of which emphasise its empirical character (Dudziak & Szpakowska, 2013, pp. 117-119).

The first concept of economic theory of risk was published by A. H. Willett in 1901. A. H. Willett noticed the diversity of commonly used meanings of the risk concept and tried to standardise it. According to him, risk is the state of the surroundings, which should be compared to the level of insecurity of its occurrence, not to the probability of materialisation. According to this theory, risk understood as the state of the surroundings is objective and related to subjective insecurity and the sensation, or rather illusion of randomness is solely the effect of the imperfection of human knowledge of objective laws that rule the processes in the outside world (Willett, 1901; Dudziak & Szpakowska, 2013, pp. 117-119).

The other concept was presented by F. H. Knight in 1921. The basic aim of F. H. Knight was an attempt to quantify insecurity. In this concept, risk is a measurable insecurity. Insecurity that cannot be measured is the insecurity in the strict sense, called by Knight the immeasurable insecurity. F. H. Knight (1921, p. 25) clearly stated that insecurity had been confused with risk, while only risk is measurable, whereas insecurity is immeasurable. It gave rise to the shortest definition of risk, saying that risk is a quantified part of insecurity (Dudziak & Szpakowska, 2013, pp. 117-119; Thornburgh, 2004).

The third basic concept was developed by Commission of Insurance Terminology of the USA in 1966. It defined risk as the insecurity regarding a certain event in conditions of two or more possibilities. Understood in this way, it is a measurable insecurity of whether the action's aim will be achieved (Dudziak & Szpakowska, 2013, pp. 117-119).

The fourth concept was developed by Nassim Taleb. He criticised risk calculations based on sophisticated mathematical models and formulated a theory, named after the symbol of the improbable, a "black swan" theory. Referring to the chaos theory, it shows the power of unpredictability. This theory says that, from the point of view of risk, managing the unpredictability or unlikely events is crucial, and in case of business decision-making, the so-called "blind chance" plays an important role (Taleb, 2006, p. 16).

As a consequence of these concepts, varying definitions of risk and insecurity have started to appear. According to the Encyclopaedia of Organisation and Management, insecurity is a situation, when you cannot determine, which elements (or at least their part) it is made of, what is their value or what is the likelihood of their occurrence. Such a situation often takes place in case of problems that had not appeared in the past and are characterised with a high level of complexity (Pasieczny, 1981, p. 33), and "risk is a situation when at least one of the elements that comprise it is not known, but the likelihood of its (or their – if there is more than one element) occurrence is known. This likelihood can be measurable, or felt only by the person taking action (making the decision). Risk conditions occur only when the existing experiences from the past related to similar events can be compared with the present situation" (Pasieczny, 1981, p. 36; Dudziak & Szpakowska, 2013, pp. 117-119).

3. Risk and risk management

Risk is not a new concept. It accompanies every business activity, in different ways. It is often associated with the danger of failure of different activities, and its negative effects are most often associated with financial difficulties. In the discipline of management, risk refers to a lot of issues, such as achieving strategic aims or innovations. Like a lot of issues related to management discipline, risk and insecurity are defined in different ways (Sierotowicz & Wójcik, 2016, pp. 272-273).

The Australian/New Zealand standard for Risk Management (AS/NZS4360, 2004) defines risk as the possibility of the occurrence of events that influence the aim. These events can either support or prevent the achievement of the aim. These events are determined on the basis of the effects they can cause or the likelihood of their occurrence. Despite the slightly general definition of risk, AS/NZ has developed and presented a five-step, system-based concept of risk management (Sierotowicz & Wójcik, 2016, pp. 272-273).

Definition suggested by EFQM (2005, p. 8), is as follows: "risk is the combination of the possibility of the occurrence of any event and its consequences". Whereas the term "consequences" is understood both as positive and negative influence on the aims. The "risk" is understood as the event itself, as opposed to the causes that evoked it (Sierotowicz & Wójcik, 2016, pp. 272-273).

Defining risk allows to undertake attempts towards proposing a system-based approach to risk management. According to EFQM's proposition (2005, p. 8), risk management: "is the systematic use of broadly understood organisation processes in order to identify, asses, manage and monitor risk – aiming at achieving total information about the danger the organisation is subject to". Formulating the problem of risk from the point of view of management allows for a complex approach to developing a risk management system. It is not only about avoiding risk, as it is not always possible, but about systematic allowance for its various symptoms in the company's activity, so that it is possible to identify its sources and consequences, as well as the ways of preventing its negative effects in the processes of strategic management – also quality management. In such a way a chance is created to develop a tool of competitive advantage, which may turn out to be the system-bases risk management in the variable market environment (Sierotowicz & Wójcik, 2016, pp. 272-273).

As risk pertains to all areas of business activity, we may hypothesise that system-based allowance for risk in the mechanism of company's efficient management will turn out advantageous in terms of achieving its activities' effects. Instead of avoiding risk, it is better to make it public knowledge, used in the company's strategy.

The issue of risk management is not a new concept. However, systematic approach seems not only innovative, but also very necessary and useful, especially when the company's surroundings is subject to frequent changes, as change and the risk level are somehow related (Sierotowicz & Wójcik, 2016, pp. 272-273).

4. System-based models of risk management

The essence of the strategy of risk management is for the company to develop efficient and effective ways of counteracting the risk present in the market. It is not about one-off ways, but rather about a mechanism, coherent with the company's strategy, which reduces risk and the danger of its negative results (Govekar et al., 2003; Willcocks, 1995; Van Grembergen & Amelinckx, 2004; Kaplan & Norton, 1996; AIMD, 1998). The diversity of sources requires a complex, model approach to the issue of risk management – Figure 1.

Figure 1. Risk management systems

Source: own elaboration.

4.1. Risk management model according to AS/NZ standard

Australian/New Zealand standard for Risk Management (AS/NZS4360) shows a process of risk management consisting of six stages (AS/NZS4360, 2004; Sierotowicz & Wójcik, 2016, pp. 272-273):

- determining the context for the organisation's activity – the sources of risk as a consequence,
- risk identification,
- risk analysis,
- likelihood of the occurrence of risk,
- effects caused by risk,
- determining the risk's priorities,
- determining the ways of handling risk,
- monitoring and evaluating the risk and the adopted plan of risk management.

The first step is to determine the context in which the organisation operates and the sources of risk. The aim is to determine which areas of the organisation's activity are more subject to the occurrence of risk. It seems that two factors play an important role here: specificity of the conducted business on the one hand and close monitoring of the surroundings' variability on the other hand. This step leads to determination of the risk's sources, hence to its identification.

After identification of potential risk, it is time for a very important step of risk analysis. Here, it is crucial to specify the nature, significance, frequency, likelihood and the effects of the risk's occurrence for a specific organisation. The results of this step are decisive for further dealing with the identified risk.

Determining the significance and frequency serves the purpose of knowing the priority (of estimating) the level of risk. This is about evaluating the level of risk in relation to the criteria of the organisation's acceptance of the given risk level. Managers must determine, whether the identified risk can be tolerated or not, due to the consequences the analysed risk may bring. The result of risk

level estimation determines further actions in the risk management system. This step allows to determine the level of risk the organisation is subject to.

The next step can be called a practical management of identified and analysed risk. If the analysed risk is acceptable, it does not mean that the organisation forgets about it. It is further monitored and verified. In case of risk that is not acceptable, monitoring and verification is not enough – it is necessary to perform consultations aimed at developing methods of actions, corresponding to the specificity of the organisation and the type of risk as well as its potential consequences. Thus, the presented process consists of three basic phases (AS/NZS4360, 2004; Sierotowicz & Wójcik, pp. 272-273):

- recognising risk:
  - determining the context,
  - identification of risk,
- determining the priority of risk for the specific organisation:
  - risk analysis,
  - risk evaluation,
- determining the response to risk.

4.2. Risk management model according to EFQM

The idea of system-based risk management proposed by European Foundation for Quality Management (EFQM), is more complex. The proposed structure of risk management is based on integrated excellence model, so one should assume that the relation between the management quality and risk management system is of fundamental significance (Sierotowicz & Wójcik, 2016, pp. 272-273).

EFQM's structure of quality management concept is as follows: (1) excellence model, which constitutes a structural basis for the use of safe risk management system in the organisation. (2) Generic Risk Assurance System, (EFQM, 2005, p. 15). It is built on the basis of five phases of the company's strategic activity in a variable market environment (Sierotowicz & Wójcik, 2016, pp. 272-273):

- policy – determines the rules and intentions related to risk management, in consultation with the owners,
- planning – developing an annual action plan containing cost distribution, setting goals and preparing a strategic multi-annual plan,
- implementation – all the activities related to risk management are included in this phase: (1) identification of risk, (2) risk analysis, (3) risk evaluation, (4) method of action – through perfecting the processes of event management,
- monitoring – relates to procedures used in the system, the possibility of registering the risk and building a data base in accordance with the facts, which would enable creating econometric models of risk management,
- verification – relates to the whole system, serves the purpose of learning and gaining knowledge.

In relation to the excellence model, the presented system of risk management is used as a constant element of strategic managing the organisation.

According to the concept proposed by EFQM, its use pertains to five areas of the excellence model – the so-called "radar" method (EFQM, 2005, pp. 10-11; Sierotowicz & Wójcik, 2016, pp. 272-273):

- leadership: the cultural aspect of risk management, leadership style in risk management, structure of risk management, obligations towards the owners, leadership in risk management during the change,
- policy and strategy: strategic planning, policy related to risk, strategy of risk management,
- people: developing the awareness of risk management in the organisation, developing competence in terms of risk management,
- partnership and resources: internal partnership management, finance management including risk management, real estate, equipment and material management, technology transfer management, knowledge and information management,
- processes: the used model of risk management translates into processes going on within the organisation.

4.3. Enterprise Risk Management – ERM

It is the most complex approach to the system-based risk management. It is not a fully unambiguous concept, as it takes different forms and meanings in various studies. Its essence is the organised process of planning, organising, leading and controlling the organisation's activity in order to reduce the effect of risk on the organisation's results.

The ERM concept includes a set of methods and techniques of identification, description, measurement, analysis and evaluation of risk and the adopted action mechanism (strategy, reaction and monitoring), directed at achieving the enterprise's aims in the context of creating and securing the value for its stakeholders.

According to *Enterprise Risk Management – Integrated Framework* – risk management in the enterprise is a process caused by the enterprise's management, designed and used in the process of developing strategy in order to identify potential events that may influence its management, in the aspect of the risk of achieving its aims. In the light of the above definition, risk management is a process that is:

- ongoing and liquid,
- caused by people and performed at each level of the organisation,
- used in the process of building its strategy,
- used by it on every level: at the level of the whole and of a part, designed to identify potential events influencing management in the aspect of risk,
- able to provide sensible guidelines as to its management,
- included in achieving aims.

4.4. Risk management according to COSO documents (1992, 2004)

In 1992, an American organisation dealing with creating good practices and education in terms of organisations' transparency COSO – *The Committee of Sponsoring Organizations of the Treadway Commissions* published a document (COSO I) titled: Internal Control – Integrated Framework.

The content of this document has been implemented in the strategies, rules and regulations of risk management in thousands of enterprises.

The framework encompasses five elements of internal audit process: monitoring, information and communication, activity audit, risk evaluation and environment control in the context of: operations, financial reporting and compliance with applicable laws.

In 2004, COSO published a document titled COSO II – Enterprise Risk Management – Integrated Framework. COSO II concept imposes special obligations ad responsibility for its implementation on individual management structures. COSO II standard does not replace COSO I. The former comprises independent framework for internal audit in an enterprise. As opposed to COSO I, it systematises the process of integrated risk management.

4.5. Risk management standard – ISO 31000(2009)

On 13/11/2009, International Organization for Standarization published standard ISO 31000:2009. "Risk management – Principles and guidelines. This standard provides principles of implementing and maintaining the risk management process in every organisation". ISO 31000 defines a set of guidelines, which are only suggestions, and hence are voluntary recommendations. They are not tasks nor contractual obligations for managers.

The standard is presented in the following sections:

- Risk management principles,
- Risk management structure,
- Risk management process

ISO 31000 is an international risk management standard.

It can be used by any organisation, regardless of its size: society, private organisations, different groups, associations performing various activities.

ISO 31000 can be used for achieving all types of aims, on all the levels and areas of an organisation.

Thus, the standard can be used in management on strategic or operating level and it can relate to decisions concerning all types of activity. It can help manage the processes, activities, functions, projects, programs, services and values.

The way ISO 31000 standard will be used depends on the manager, on the needs of a given organisation, on what it does and how.

The standard is designed to:

- increase the probability of achieving aims by the organisation,
- increase the identification of chances and dangers,
- enhance management efficiency, improve audit quality,
- create a cognitively established basis for decision-making and planning,
- make an effective division of and use the resources in order to reduce risk,
- minimise losses,
- improve organisational learning,
- improve organisational stability,
- improve health and safety, as well as environment protection,
- increase the shareholders' level of trust for the organisation's management, perfect financial book-keeping.

4.6. KonTraG

KonTraG – German act of control and transparency in the enterprise. It has been in force since 1998 and it relates to joint-stock companies. It obligates the companies' managements to implement a supervision system and to include the information about risks related to the company's further activity in financial reports. Under his act, a statutory auditor is obliged to point to irregularities in performing activities requiring professional diligence. The auditor verifies the scope of responsibilities within the company's bodies and management, which has a significant influence on potential claims and the accuracy of evaluation of future risk included in the report. The latter contains a prognostic part and risk report. The act has introduced a lot of prudential norms, demanding that companies identify the most significant risk for the company's functioning. The act's concept is based on a process approach to risk management.

5. Conclusion

Negative events of global range and macroeconomic significance have become determinants for the development of standards and guidelines of risk management. Tools and techniques of risk analysis and control can be useful in every business activity, regardless of its type, form or size. In large enterprises, they create a complex approach to risk management, which is integrated with the organisation's culture and supports the company's management system. Expanding scope of business creates a stronger need for systematisation of the methods of efficient use of resources and safeguarding against unfavourable external factors. A solution that is used more and more often is supporting the general management system of the company with risk management system developed on the basis of frameworks indicated in the standards.

All the described models emphasise a dynamic character of risk management. This process is integral for the organisation's strategy of action. At the same time it is a multi-level process, involving all the members of the organisation. It is worth noticing that these models are universal and scalable, so it is possible to adjust them to the size and needs of the organisation, as well as to the specificity of market environment.

System-based risk management is without doubt a useful tool. It creates opportunities for developing an effective way of functioning in a dynamic environment and it is an effective tool of reducing risk, by means of minimising the dangers and maximising opportunities for quicker growth.

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Chapter 7

Risk Optimisation as Part of Bancassurance Agreements

Ryszard Pukała

1. Introduction

Contemporary global economy is exposed to perturbations resulting from recurrent economic crises as well as integration and globalization processes taking place in the global dimension. These phenomena translate into all segments of economic activity, including the financial market, which plays a key role in the process of accumulating and redistributing financial resources in each country's economy. Market's reliability and perception of entities operating there impose on these entities an obligation to take care for financial security of clients and own reliability under changing conditions of economic environment.

As regards the process of achieving financial security, the banking sector is of key importance, as it accumulates financial resources, therefore it should be characterized by highest standards in providing security. Similar situation takes place as regards the insurance sector, which provides protection and compensation to its clients, thus it should act as support in the event of random incidents that adversely influence everyday operation.

Risk and risk management mechanisms represent common elements that characterize both segments of the financial sector. Market success of most enterprises, including banks and insurance companies, depends on efficient risk identification and implementation of solutions that minimize losses resulting from risk materialization.

Banks and insurance companies operating under market conditions, through the use of a synergy effect, have an opportunity to lower insurance acquisition costs. What is more, it is economically advantageous for both sides: banks, which are usually rewarded by insurance companies for their involvement in the sale of insurance products, and insurance companies, due to the increase in the insurance premium written. It cannot be neglected either that this situation is creating favourable conditions for banks' clients, who obtain easier access to insurance protection with the bank's assistance.

2. Bancassurance arrangements on the financial market

In market economy enterprises compete with one another, but in spite of a natural inclination to rivalry aimed at gaining competitive advantage and fostering development, we can observe numerous forms of collaboration within the framework of their operation. Cooperation plays a fundamental role in the functioning of contemporary business entities and it consists in sharing knowledge, experiences, implementing new know-how and undertaking common initiatives. The environment the entrepreneurs are active in – characterized by high degree of complexity – forces the quest for new sources of competitive advantages (Stanienda, 2012).

Enterprises operating under such conditions develop and implement new products and services related to technological progress, integration processes taking place and new forms of production cycle management. They are forced to:

- quickly react to changes and implementations of new technologies, solutions and products in line with their clients' expectations,
- foresee changes in competitive environment and identify areas that have the greatest impact on this environment,
- adapt to multidirectional changes in the market environment,
- create new solutions and new values for clients,
- look for partners to mutually execute new undertakings that bring about common, tangible benefits.

Therefore, cooperation mechanisms and execution of common undertakings gain special significance for enterprises under competitive conditions, as they allow to enter new business areas and integration processes.

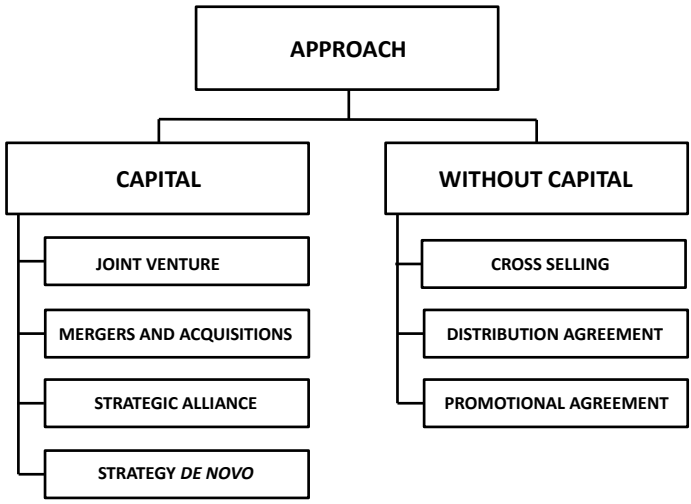
Cooperation between enterprises active in different sectors of the economy depends on a broad range of factors that influence the selection of integration models aimed at fulfilling economic objectives. We have to stress that we understand integration as a process of connecting separate components into a system, which results in forming a comprehensive economic mechanism.

A classic example of such cooperation are links between banks and insurance companies, who see a chance for further development and gaining new sources of revenues. We need to underline that legal regulations governing the financial market do not prohibit banking and insurance relations, therefore each cooperation model is legally permitted. In practice, this form of cooperation often takes place on numerous planes and is based on elaborating mutually beneficial solutions, aimed at increasing efficiency of partners' operation. Such form of collaboration is known as bancassurance and is defined as (Penc, 2008):

- a strategy used by banks and insurance companies aimed at providing services to natural persons in a more or less integrated form,
- a course of creating hybrid services and bancassurance products,
- joint offering of own products by a bank and an insurance company as part of established collaboration,
- constant link between a bank and an insurance company, which is aimed at offering banking and insurance products as part of existing banking structures,
- a process of entering the insurance sector by banks through offering insurance products to retail clients.

Cooperation forms are based on various legal, formal and organizational solutions (see Fig. 1).

Figure 1. Bancassurance forms



Source: (Cichy & Szewieczek, 2012, p. 32).

Contemporary models of bancassurance groups' operations are aimed at altering organizational structures, which results in reaching an optimized business activity. Through implementing various types of collaboration mechanisms, these groups try to:

- gain access to partner's potential and infrastructure,
- manage collective competences along the value chain,
- disperse and limit operating risk,

which in consequence should lead to an increased market potential.

3. Operating risk as part of bancassurance

Risk means uncertainty, a threat to assumed targets, an activity with unknown results. It is either a possibility of success, or a failure. It is characteristic for all areas of business activity and everyday life. One has to bear in mind a possibility of failure while working under risk. Risk is defined as a possibility of event that can adversely impact the execution of assumed goals. On the other hand though, the concept of risk is also related to possible benefits.

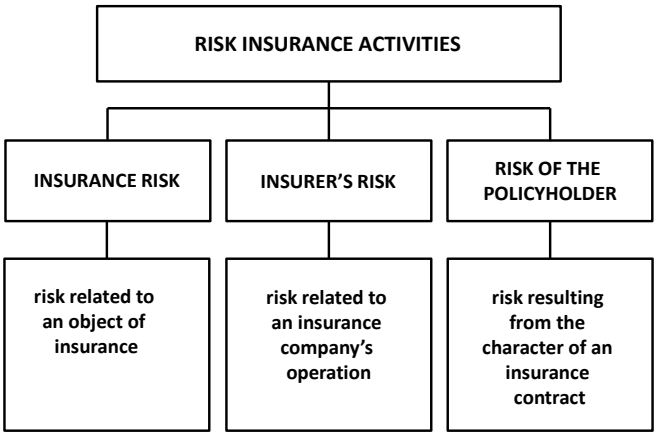
3.1. Risk in the field of insurance activity

Risk can be observed along the entire line of insurance activity. Insurances are aimed to protect a person or its enterprise from results of unpredicted events that are a consequence of the sheer existence of risk. Risk analysis should be a key task to be performed before entering into an insurance agreement, both for an insurance company and for an insured person. Risk stems from all sorts of threats to human existence, including natural disasters. As a consequence of the development

of civilization, technology, culture, trade and other aspects of modern life, new areas of human activity generate new types of risk. We also have to take account of the risk related to the loss of health, ageing or death. Methods of dealing with situations marked by risk have been sought for long, through reducing, avoiding or combating risks. These methods are defined as risk sharing and collectively called "risk management".

The problem of risk related to insurance activity can also be seen from another perspective. Insurance companies conduct an insurance activity and their operation is also marked by risk. We also need to note the existence of one more risk type, which results from the fact that insurance agreement is concluded between an insurance company and an insured person, which means that risk can appear also on the other side of the contract, as a result of an insurance company's insolvency or failure to fulfill all provisions of the contract by an insurance company (Łupicka, 2010). The following risk categories occur in the field of insurance activity – see Figure 2.

Figure 2. Risk experienced by insurance companies



Source: (Jajuga, 2007, p. 293).

Risk in the field of insurance activity results from factors related to its environment (e.g. macroeconomic factors, insurance awareness, financial market development) as well as from internal operating conditions (e.g. activity related to concluding insurance agreements, reinsurance activity).

An insurance company is an institution that operates on a certain market and within a certain area. Risk that accompanies an insurance company's activity can be divided into (Swacha-Lach, 2008):

- external (systemic) risk, beyond the entity's control. We are talking about risk related to natural forces and economic conditions of a given market, including the global one,
- internal (non-systemic) risk, covering the area of a given entity's operation and controllable by this entity. The areas where internal risk can occur include marketing operations, corporate management, liquidity, solvency and bankruptcy.

The abovementioned division is presented in Table 1.

Table 1. External and internal risk factors influencing insurance companies' operations

INTERNAL	EXTERNAL
• financial activity • reinsurance • activity related to concluding insurance agreements • activity related to claim settlement and determining the amount of benefits and compensations • management	• financial and insurance market development • amendments to legal regulations • technological progress • macroeconomic factors (inflation, gross domestic product, changes in income) • insurance awareness • increase in insurance-related crime

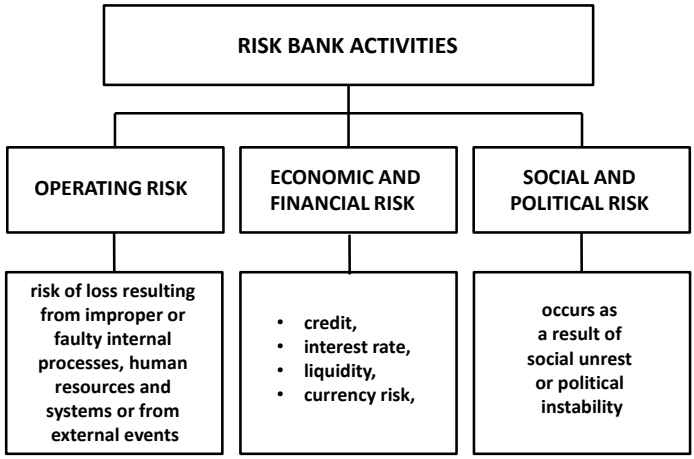
Source: (Gąsiorkiewicz, 2009, p. 285).

Therefore, risk experienced by an insurance company means events that can but not necessarily have to take place In the future. However, if they do, they will generate financial losses.

3.2. Risk in the field of banking activity

A bank is an organization functioning within the limits of economy, striving to reach assumed goals while at the same time experiencing risk. Through taking risks banks obtain and multiply their profits. Further chain of events cannot always be foreseen. The term "risk" is defined, among others, as a threat of non-fulfilment of assumed goals. To a bank it means reduced profits and equity, loss of liquidity, financial difficulties or bankruptcy. Risk is an event that adversely impacts the bank's situation. However, there are situations where a chain of events can contribute to the improvement of a bank's overall condition by giving rise to additional benefits (e.g. better exchange rates). The banking risk is related to the majority of transactions executed by the bank. Risk relates to such terms as uncertainty and possibility of losses. Uncertainty refers to the future course of events that influences the bank's operation, while experiencing losses is a materialization of risk (Jajuga, 2007). Basic types of banking risks are presented in the Figure 3 below.

Figure 3. Classification of banking risks



Source: (Dmowski, Sarnowski & Prokopowicz, 2005, p. 344).

The extent of risk in banking activity depends on plenty of factors. We can divide them into external and internal ones. Examples of these factors are presented in Table 2.

Table 2. Examples of external and internal risk factors influencing the banking activity

INTERNAL	EXTERNAL
• macroeconomic factors: change in purchase parity of domestic currency, change in the value of market parameters, growing budget deficits and indebtedness of developing countries • regulatory factors: amendments to regulations governing the banks' operations, deregulations, amendments to fiscal or currency laws • supply and demand factors • limited role of banks as traditional financial intermediaries • other factors, e.g. natural disasters, catastrophes, terrorist attacks	• employees' qualifications, their attitude to duties, employees' behaviour and honesty • technological progress, development of IT and telecommunications

Source: own study based on (Górski, 2009, p. 219; Zalewska, 2007, p. 289).

Apart from the abovementioned factors, literature lists new tendencies on international financial markets, occurring from mid-1970s, as a significant one. The most important tendencies include (Dmowski et al., 2005):

- liberalization, that is, deliberate uplifting of restrictions concerning the functioning of financial markets by governments. This tendency broadened the spectrum of operating possibilities for banks and other financial entities, including foreign ones,
- integration of economies, resulting from aspirations to achieve international division of labour and integration,
- technological progress, which has enhanced data processing possibilities by increasing their transfer speed. It has led to the reduction of unit costs of transactions and contributed to a further broadening of the scope of application,
- globalization of financial markets, which consists in linking national and international financial markets,
- securitization, collateral in the form of securities. Costs are borne exclusively by an investor and a depositary,
- change in the structure of bank's clients, particularly a growing number of bank clients who professionally manage their funds,
- development of new banking transactions, such as mass derivatives or sovereign bonds, including forward transactions, options and swaps.

The abovementioned tendencies have contributed to the growth of risk on international markets. Risk has grown proportionally to operating extent of banks. The globalization process has broadened the scope of members of the financial markets, whereas liberalization and deregulation have increased opportunities on local markets, thus creating new chances and risks.

4. Bancassurance risk management tools

Risk aversion prevails in business activity. This means that the more risky a decision, the better the expected result should be. However, the higher the risk aversion level, the higher bonus a decision-maker should obtain for the risk taken. Behaviors characterized by indifference to risk or inclination to risk are undesired as regards business activity. Considering the presented activities, it results that a given entity makes a risky decision only if risk is compensated by adequate benefits. This means an obligation to measure the risk taken by an entity and to undertake actions that adapt the extent of risk taken to the level acceptable by the entity. The abovementioned activities are included in the risk management framework. We can thus say that management means making decisions (Jajuga, 2007).

Entity risk management means making decisions and performing tasks leading to reaching an acceptable risk level. Risk management consists of coordinated activities, policies and procedures established by unit's executives and workers, who by carrying out risk analysis increase the probability of fulfilling objectives or completing tasks. A basic condition for each risk management system's efficiency is adaptation to an individual (Komunikat Nr 6…, 2012). A risk management entity can be, among others, an enterprise, public sector entity, financial institution or household. Risk management constitutes an inseparable part of its strategy.

An implemented and well-maintained risk management system engenders numerous benefits, such as (*Zarządzanie ryzykiem. Informacje ogólne.* Departament …, 2011):

- an opportunity to increase the probability of reaching goals,
- minimization of losses,
- improvement of financial reporting,
- efficient utilization and allocation of resources to deal with risk,
- encouragement to active management,
- improvement of control mechanisms,
- raising awareness of the need to deal with risk,
- strengthening stakeholders' trust in organization.

Risk is a part of every business activity. An entrepreneur encounters various types of risk along the line. Inclination to take risks depends on decision-maker's viewpoint. Risk management represents the main element of each organization. It is a process where an entity solves risk-related problems in such a manner that generates durable benefits.

Banks and insurance companies are exposed to those risk categories that depend on their operation's character – Table 3.

Table 3. Comparison of criteria and risk in financial sectors

Criterion	Insurances	Banking
Main assets	Investment portfolio	Credits, inter-banking assets, securities
Main liabilities	Technical provisions	Client deposits, inter-banking commitments
Time horizon	Long-term: life insurance, Long/short term: property insurance	Medium-term
Main risk types	Insurance, investment	Credit, market, liquidity
Risk transfer mechanisms	Reinsurance	Securitization, credit derivatives, OTC derivatives
Main supervision areas	Insurance protection	Systemic risk

Source: (Gołąb, 2012, p. 131).

Despite the fact that insurances and banking are both parts of financial market sectors, there are fundamental differences between them in terms of assets, liabilities, time horizon and types of risks. This is of considerable importance for the operation of capital groups taking the form of financial conglomerates. Despite numerous differences between insurance companies and banks, we have to note that both entities struggle to reach an acceptable risk level, to minimize losses, to increase the probability of reaching goals and to reinforce stakeholders' trust in the entity.

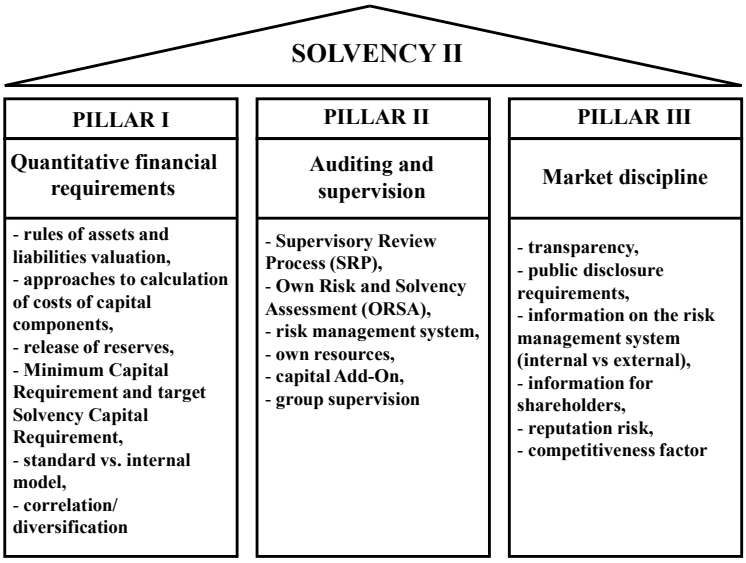
4.1. Solvency II

Changes taking place on the global insurance market, changes in various risk management techniques and accounting standards, globalization processes, amendments to EU legislation as well as more dynamic financial instruments had led to a situation where regulations in the scope of insurance companies' solvency applicable in EU Member States for decades had ceased to respond to new challenges. Therefore, it was crucial to introduce a reform of the existing system, aiming at creating a solvency system that would take account of risk profiles characteristic for insurance and reinsurance companies (*Wypłacalność podmiotów sektora …*, 2016).

Insurance companies function on the basis of numerous requirements that guarantee their operating security. The fundamental criterion of assessing financial standing of an enterprise is solvency, that is, capability of timely payment of liabilities. A solvency margin concerns one of the basic requirements of insurance activity. A solvency margin is a volume of an insurer's own funds specified by law, which is there to safeguard solvency. It cannot be lower than minimum guarantee funds (*Zarys systemu Solvency II*…, 2016). At the same time, along with the development of the insurance market and emergence of new products and risks, the existing solvency margin requirements had ceased to fully reflect all risks that burden insurance companies. A number of risk and bankruptcy analyses as well as analyses of existing solvency models were carried out. The study resulted in the introduction of a new solvency system – Solvency II – in 2001 by the European Commission as part of the European Committee. The introduction of Solvency II was triggered by a number of imperfections in regulations of that time that dealt with solvency, e.g. methods based on a premium that failed to take account of significant risks, lack of relations between assets and liabilities, lack of absolute risk transfer forms and the scope of activity. The idea behind Solvency II consists in a more precise conditioning of capital on the extent of risk taken by insurance companies. The Solvency II model places solvency regulations in three pillars – Figure 4.

The first pillar of the system (quantitative risks) is related to capital issues and determines minimum financial requirements. The aim of the second pillar (eligible risks) is, among others, to improve risk management and facilitate internal control at insurance company. The second pillar focuses on supervision processes adapted to specificity of a given insurance company. A significant aspect of the second pillar is determination of common prudential supervision instruments (e.g. standardization and harmonization of early warning indices, standardization of control procedures applied by domestic supervisory bodies). The third pillar (transparency) focuses on establishing uniform requirements that concern transparency of an insurance company's operations. It is aimed at achieving greater transparency of a given company through establishing specific rules in the information sphere (*PIU Historia*, 2016).

Figure 4. Insurance supervision model as part of Solvency II



Source: (Stroiński, 2008).

Information concerning Solvency II is included in Directive of the European Parliament and of the Council of 25 November 2009 on taking-up and pursuit of the business of insurance and reinsurance (Solvency II) (Iwanicz-Drozdowska, 2013). The system came into effect in insurance companies on 1 January 2016.

4.2. Basel II

The beginnings of the Basel regulations date back to 1974. These regulations were a consequence of bankruptcy of the German Herstatt Bank. This bank, a year before it went bankrupt, had indebted itself considerably due to losses on foreign exchange transactions (USD – DM). These losses exceeded the amount of equity by four times. In spite thereof, the bank continued its operation. In June 1974 the bank's licence was annulled. The value of its liabilities was over twice as high as the value of assets in stock. Moreover, at the moment the bank's licence was withdrawn, the bank was in the course of settling a foreign exchange transaction. Taking account of time differences, the bank obtained German marks from a client, but failed to supply the client with American dollars. Taking this settlement risk caused trouble for other banks (Herstatt Bank was supposed to supply them with foreign currency) and triggered difficulties in liquidity concerning foreign currency on the market (*Pakiet CRD IV*…, 2016). In response to these events, the G-10 group established a standing committee – the Basel Committee on Banking Regulation and Supervisory Practices, later renamed to the Basel Committee on Banking Supervision, BCBS). Its task was to propagate appropriate international banking risk management standards and to eliminate deficiencies as regards the banking supervision system. The consequence of the committee's establishment was the first agreement dealing with minimum capital requirements for

banks, the so-called Basel I, which entered into force in 1988. Despite the fact that it was mainly addressing internationally operating institutions and that it was legally invalid, it was generally implemented to the applicable law in most countries of the world, particularly to given banking and legal systems. The most important concept of these regulations was to maintain the lowest possible ratio of capital to credit risk-adjusted assets by banks at the level of 8%.

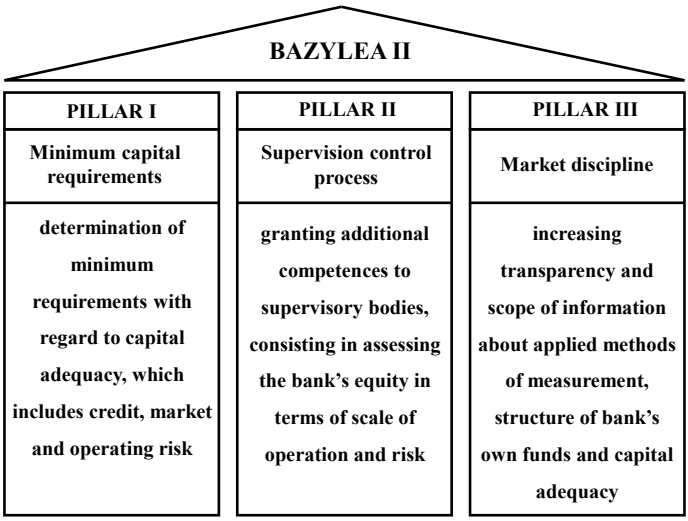
The Basel principles were supplemented in 1996 with issues related to trading activity of banks and capital requirements concerning market risk.

Subsequent changes were introduced in the wake of bankruptcy of an English Barrings Bank. The crisis was caused by non-approved transactions of one employee, which became a stimulus for a complete modernization of applicable standards and an establishment of a comprehensive solution dealing with banking risk management and capital standards. As a result of these events the New Basel Capital Accord was worked out, also known as Basel II.

The initial effective date of Basel II was set for 2004. However, the date was frequently changed due to discussions in the banking environment and the need to verify arrangements by means of quantitative analyses. The aim of these analyses was to establish the impact of the New Basel Capital Accord on minimum capital requirements. The definitive entry of Basel II into force took place in January 2007 by introduction to the banking law of all G-10 Member States (Krasodomska, 2008).

The New Basel Capital Accord consists of three mutually supportive pillars (Fig. 5). According to the Committee's findings, the pillars constitute a coherent entirety. The complete implementation of the New Basel Capital Accord obliges banks to simultaneously apply all pillars, since incomplete application does not provide adequate security of the financial system and sufficient stability.

Figure 5. Basel II structure



Source: (Krasodomska, 2008, p. 60).

The first pillar focuses mostly on calculating a sum total of minimum capital requirements. It consists of three basic elements (Krasodomska, 2008): risk-adjusted assets, definition of regulatory capital and minimum solvency ratio. The second pillar provides for such tasks as safeguarding compliance of the bank's financial position with an overall strategy and risk profile and making it possible to make initial decisions by supervisory bodies (Adamus-Matuszyńska, 2007). The third pillar should adjust information and reporting procedures to the scope of information disclosures provided for by the New Accord. Furthermore, it focuses on tools and methods of maintaining market discipline by banks. Regulations in this pillar refer to improved transparency as well as availability and quality of information concerning banks. Guidelines included in the New Basel Capital Accord aim at bringing detail and scope of information made public by banks to an optimal level. A bank is not obliged to disclose all information, since it would violate the principle of operating confidentiality and threaten the activities of financial intermediaries.

The work on the implementation of Basel III is under way. The introduction of an amended version of the New Basel Capital Accord (Basel III) should take place in January 2019. It is supposed to strengthen banks' security from the point of view of economic stability and to prevent an excessive credit growth.

5. Conclusion

Cooperation of banks and insurance companies as part of bancassurance is undoubtedly an advantageous solution for numerous banking and insurance institutions. Bancassurance has also set the new development direction both for insurance and banking markets. We should not forget either that the entire financial market has benefited a lot owing to bancassurance. However, we need to stress that just like any other activity, this form is also burdened with risk. Risk and accompanying phenomena create an inescapable element of banks and insurance companies' operation. Adequate risk management procedures and methods allow to more precisely forecast adverse phenomena that can have impact on business operation. Therefore, the implementation and observance of procedures aimed at limiting operating risk, accumulation of capital that enables safe operation and safe execution of contracts concluded with clients is an important factor optimizing operating risk of financial institutions.

Public trust institutions, such as banks and insurance companies, have implemented operating risk management mechanisms. These are Basel II and Solvency II. They allow monitoring operating risk and adapting the level of equity to the extent of risk. It needs to be underlined that the implementation of new solutions will contribute to the performance of a more cautious business activities by banks and insurance companies, which in turn will contribute to the strengthening of the market in terms of financial security of institutions and clients.

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PART II

CONDITIONS AND FACTORS IN MAKING EFFECTIVE DECISIONS ON THE FINANCIAL MARKETS

Chapter 8

Investments in Innovation: How the Russian Financial Market Reacts?

Elena Rogova, Daria Guseva

1. Introduction

Though innovation activities play a crucial role in the creation of sustainable competitive advantages for companies, investments in innovation projects are expensive and long-term, and they must compete for limited financial, material and human resources. Thus, the issues of effectiveness and economic pay-off of innovation investments are of primary concern. Since a basic postulate of modern investments and financial management is a company's value maximization for investors and other stakeholders, any investments should be value-oriented. That is, the investments should be directed towards reaching economic goals set by the major stakeholders of the company, and the return on the invested capital must meet the expectations of the stakeholders and be appropriate for the level of risk involved.

In recent years, an increasing amount of academic literature on innovation examined the effects of innovation on firm performance measures like market share, sales and profits (Anand & Khanna, 2000). Notwithstanding, these measures are subject to many other strategic and environmental factors so that the causality between them is not quite clear for investors. To understand how the market reacts towards innovation, we studied abnormal returns on stocks of publicly traded companies. They characterize the profitability of innovation projects from the investors' standpoint and thus give an answer to the question of whether these investments create value.

The objective of this study is the market reaction to announcements about innovation projects of Russian companies.

2. Market returns on innovation events, activities and projects

In this study, we identify three distinct types of innovation activities during the innovation project life cycle – initiation, development and commercialization. Each activity contains key events related to the overall set and may occur any time during the innovation project development. For example, firms may decide to enter into new alliances any time during the innovation project. Moreover, these events may be either positive (patent registration) or negative (patent denial).

Total market returns on the whole innovation project are the sum of returns on all activities during the innovation project. Currently, the literature reports demonstrate controversial findings about the question of whether returns on each of these events are negative or positive, as described below.

The first type of activity is project initiation. Initiation mainly includes events connected with alliances' formation, funding and distensions for innovation projects. On the one hand, announcements about initiation activities may lead to negative returns because of the high amount of investments, long gestation periods, and the high risk of failure (Crawford, 1977; Kelm et al., 1995). On the other hand, such announcements enable market expansion, deter competitor entry, improve probability of success and enhance firms' competitive position (Suárez, 2002; Anand & Khanna, 2000; Doukas & Switzer, 1992). Thus, they may cause positive returns.

The second type is development activities. They include events connected with the creation of working prototypes and their first demonstration, finding new materials and technologies, patents etc. On the one hand, announcements about development activities may lead to negative returns because they alert competitors of progress, reduce the element of surprise or lead to excessive discounting of the technical content. On the other hand, returns on development activities may be positive because of overall uncertainty reduction, signaling confidence, competence and optimism about the future (Zantout & Tsetsekos, 1994; Austin, 1993; Pakes, 1985; Sorescu et al., 2007).

Finally, we observe the commercialization activities, which include events connected with the launch of a new product in the market. Again, on the one hand, announcements about commercialization events may lead to negative returns because launched products fall below expectations, costs of promotion and launch seem high or the competitive advantages from the launch seem fleeting (Crawford, 1977). On the other hand, announcements on commercialization events may lead to positive returns because they demonstrate the high level of firm competitiveness, the successful completion of innovation project and the expansion of the product portfolio (Sood & Tellis, 2009; Chaney et al., 1991).

The latest research studies have estimated returns to partial isolated events of an innovation project. This approach may lead to a substantially incorrect estimation of the total market returns on innovation. In this study, we propose that we may only estimate the total returns to innovation if all events in all types of activities related to an innovation project are included in the analysis. If the returns to the entire innovation project could be estimated from a single, target event during the project, then returns for other events would not be significantly different from zero (Chaney et al., 1991). That target event would be critical with important implications for firms and investors. In other case, if firms continue to experience incremental returns to various events over the innovation project, ignoring certain events would result in an incorrect estimate of the total returns on innovation. It would also mean that firms and investors should pay close attention to all innovation-related events and optimize their announcement and investment strategies.

The total returns on innovation are the sum of returns on all events included in an innovation project. Similarly, if a firm has multiple innovation projects running simultaneously, the total returns on innovation to the firm are the total return on all innovation projects of the firm.

In addition, the benefit of considering all events in an innovation project is that it compensates for the non-optimality or strategic announcements of the firm. For example, if the firm promises less profits in the early stages of an innovation project and delivers more in later stages, the possible low market returns in the early stages will be compensated for by high returns in the later stages. Conversely, if a firm gives too many promises and then delivers less results, considering all events will compensate for possibly too-high returns in earlier stages.

Many empirical studies report that announcements on commercialization activities may bring the highest market returns for several reasons. Firstly, only commercialization activities attract the biggest part of the total profit of an investment project in terms of revenues from sales of the new product (Sharma & Lacey, 2004). Secondly, based on research to date, commercialization activities get the highest level of attention from reporters.

3. Tendencies in innovation activities in Russia

As a country with skilled research and development personnel and a strong research infrastructure, Russia looks rather modest in relation to using innovation potential. As Table 1 demonstrates, Russian enterprises on average do not increase their level of innovation activities.

Table 1. Innovation-related dynamics in Russia

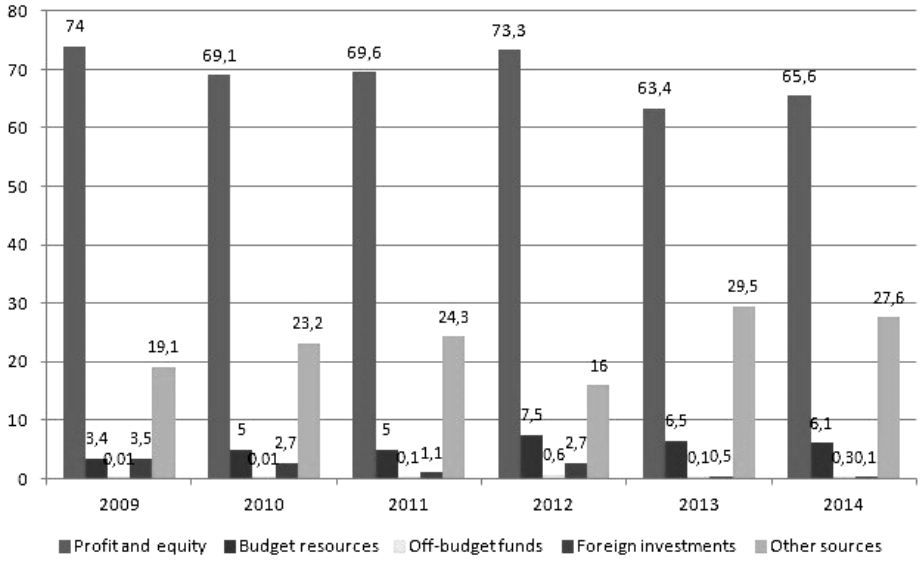
	2009	**2010**	**2011**	**2012**	**2013**	**2014**
Share of organisations implementing technology innovation in the whole number of organisations (without small enterprises) [%]	7.7	7.9	8.9	9.1	8.9	8.8
Expenses for technology innovation, % to previous year (in constant prices)	127.4	85.3	115.8	115.8	121.8	95.3
Share of newly launched products (services), % to total output	5.0	4.9	6.1	7.8	8.9	8.2
Share of small enterprises implementing technology innovation, [%] (for small and enterprises the statistic data is collected at biannual basis)	4.1	-	5.1	-	4.8	-

Source: (*Indicators of...*, 2015).

To compare, Russia is far below the majority of European Community (EC) countries in terms of the level of innovation activities (the highest level is fixed for Germany – 55% and the lowest for Romania – 6.3%, and this is the only country that Russia exceeds), USA (14.5%) and the majority of emerging economies.

Though the government steadily increases the volumes of research and development funding, the main source of funds is enterprises' profits and equity (Fig. 1).

Figure 1. Sources of innovation funding, 2014



Source: (*Innovation Statistics*, 2015).

This distribution of sources makes investors' expectations about innovation returns very important.

4. Methodology

4.1. Event study method

To reveal investors' reaction to the news of companies' investments in innovation projects, we estimated abnormal returns by the method of event study analysis. Foundational work on event study analysis goes back to the late 1960s. Ball and Brown (1968) looked at the market response to announcements about companies' financial results. Fama et al. (1969) investigated market reaction to information on company stock splitting. Based on the notion of an efficient market that will respond immediately to any consequential events, the objective of event study analysis is to assess the impact of specific events or happenings on company performance through the market reaction to these events. If an event is perceived to have a positive impact on company performance, the stock price for that company will go up, and if the event is perceived to have a negative impact on company performance, the stock price will go down. In terms of this research, we define each innovation announcement as an event.

Total returns on innovation are understood as cumulative returns to all events within an innovation project. To complete an event study, we performed several steps.

The first step is the identification of events, that is, in our study the identification of announcements of IT investments by publically traded companies in Russia (at Moscow Interbank Currency Exchange, MICEX). We used the Factiva and Emerging Markets Information Service

(EMIS) databases for this purpose, limiting our study to announcements in the period 2010–2013. The event day is defined here as the first day in which the news about the innovation project appeared. Our primary sample contained 149 announcements. In the second step, we used an 11-day event window to test for any abnormal behavior in company share returns. Periods of five days before and after (-5, +5) the announcement date are studied in this section. The reason for using an event window rather than just a single day is that the majority of innovation information is not necessarily quickly incorporated into share prices; it also may leak out before formal publication or is held back. Though in academic literature different periods are considered as event windows, our choice aligns with event windows proposed in papers where investments in projects are discussed (Chaney et al., 1991; Sood & Tellis, 2009).

At the third step, we have to look for possible confounding news published in the period of the event window. Such news may include takeover bids, government contracts, dividend declarations, profit announcements, split announcements, complaints, claims, court cases or labour disputes. So we are sure that no other corporate event had an influence on the stock prices within the event window.

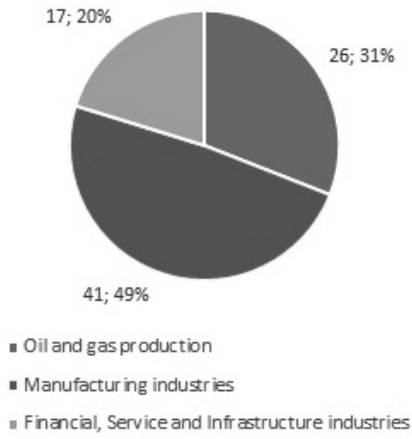
The fourth step estimates the market model after collecting data on market measures of performance, especially market returns on the share price. Using different frequencies, for example daily, weekly, monthly and annually might lead to distinct measures, but the daily news collection procedure employed requires the use of daily returns. In terms of research, market measures provide information on the value of the firm.

The raw data contain the daily returns on the share prices of the firms, which made the innovation's investment announcements during the period. These daily returns are settled for dividends, subscription rights and splits. Considering the limitations of the third and fourth steps, we formed our final sample of 84 announcements. Although this sample size could seem to be small, in terms of the research for this period, the size is enough for detecting market reactions and dynamics of share prices (Nicolau & Santa-María, 2013). According to the previous research studies, we chose the estimation period of 240 days. It is long enough to observe the dynamics and create a valuable model for market returns estimations, but at the same time we included only shares that were traded daily and thus excluded the probability of excesses.

4.2. Sample characteristics and research hypotheses

As shown in previous event studies, the market reaction to the announcements may depend on several factors. First is the sector of economy where an innovation investment was made. For example, high tech industries could be more sensitive to innovation than low tech. We detected three groups of industries. Figure 2 visualizes the distribution of the announcements in our sample by industry sector.

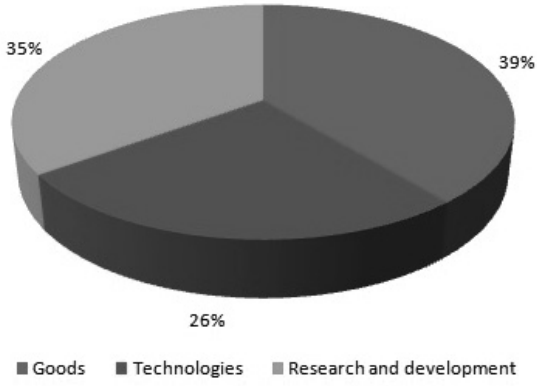
Figure 2. Distribution of announcements by industry sector



Source: own elaboration.

Similarly, we may divide the announcements into different types according to the type of project where a company invested. In our study, we defined three classes of projects: goods (new products or services ready to launch at the market), technologies and research and development investments. Figure 3 represents this distribution. We suppose the more considerable reaction for the first type of investments, as new products may have an impact not only on the company itself but also on its customers. Other types bear more risks, and therefore, the reaction could be weaker.

Figure 3. Distribution of announcements by the type of innovation project

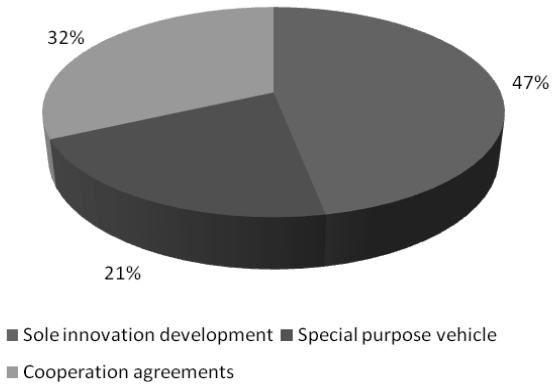


Source: own elaboration.

Finally, the response may depend on the mode of investment. In this relation, we defined three modes of investment. First, a company may implement the project solely. To mitigate risks, it may create a spin-off company (special purpose vehicle) for innovation project development. The third

way is cooperation via joint ventures or strategic alliances. We suppose that the creation of special purpose vehicles (SPV) would not cause a growth in returns because the name of this enterprise may be unfamiliar to investors. The reaction to cooperation may be controversial depending on the nature of the cooperation agreement and its participants. Figure 4 demonstrates the distribution of announcements by these criteria.

Figure 4. Distribution of announcements by the mode of investment



Source: own elaboration.

Based on previously published event studies and in accordance with the various classifications of our announcements as shown in Figures 2, 3, and 4, we established a set of research hypotheses.

H1: The market reacts differently to innovation investments from companies in different industries.

H2a: The market response differs depending on the type of innovation.

H2b: There is a high abnormal market return from innovation in goods (products and services).

H3: The market reacts more positively to innovation investment announcements when the investment is done through a major company or through a cooperation agreement than through a special purpose venture.

4.3. The model

To test the reaction of the market to announcements, we must calculate the abnormal returns. According to the market model by MacKinlay (1997), the estimated expected return, based on the stock performance during the estimation period, is calculated as:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{1}$$

where:

R_{mt} – the expected market return at day t,

α_i and β_i – estimation parameters for the expected return calculated based on the estimation period, and

R_{it} – the actual return on the security i at day t, based on the closing prices of the shares on the Moscow MICEX stock exchange,
ε_{it} – the regression error.

To assess the market reaction to innovation investment announcements and test our hypotheses, we look at the abnormal returns of the investigated stock, which is calculated as the difference between the actual return and the estimated expected return, based on the stock performance during the estimation period:

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \quad (2)$$

where:
AR_{it} – the abnormal return on the security i at day t.

Cumulative abnormal returns *(CAR)* can be calculated by summing the *AR* for the days of the event window.

The sample presents the panel data, and to test our hypotheses for significance correctly, we must calculate average abnormal returns and cumulative average abnormal returns. To calculate average abnormal returns for each of the days in the event window, AAR_t, we should find the mean of abnormal returns of all the stocks in the population as follows:

$$AAR_t = \sum_{i=1}^{N} AR_{it} \quad (3)$$

where:
N – the number of events.

Cumulative average abnormal returns *(CAAR)* can be calculated by summing the *AAR* for the days of the event window:

$$CAAR_{T_1,T_2} = \sum_{t=T_1}^{T_2} AAR_T \quad (4)$$

The last step is testing the null hypothesis for significance:

$$\begin{aligned} H_0 &: E(CAAR) = 0 \\ H_1 &: E(CAAR) \neq 0 \end{aligned} \quad (5)$$

For testing our hypotheses, the Pattel (1976) and Corrado GRANK (Charles et al., 1992) statistic tests were applied.

5. Results

Table 2 shows the cumulative average abnormal returns for the sample by industrial sectors.

Table 2. Results by industry sector

Industry	CAAR	t Pattel	t-GRANK
Finance, service and infrastructure	-0.0016	0.7274	0.5563
Manufacturing	0.1572	0.4823	1.0290
Oil and gas	-0.0013	0.0301	-0.0768

Source: own elaboration.

The results in Table 2 show that none of the results is statistically significant. There is no significant difference in the stock market reaction to innovation investment announcements by industry sector, and it is the rationale for rejecting hypothesis H1. The probable explanation of this result could be the unequal population through the sub-samples that does not let to capture the differences in industry sectors' reaction. If the number of announcements in each sub-sample increases, the hypothesis testing could be revised. The longer event window is the other way to justify the hypothesis.

Table 3 demonstrates the returns for different types of innovation projects. The results prove hypothesis 2a: returns differ depending on the project type. News on investments in research and development generates the positive abnormal return. We may explain this fact with the long-term nature of investors' expectations and their strategic intent.

Table 3. Results by the type of project

Project type	CAAR	t Pattel	t-GRANK
Research and development	0.0130	*2.0869**	*2.6064***
Goods	-0.0048	-0.3661	-0.6188
Technologies	0.2527	-0.4758	-0.1855

* – significant at the 5-% level; ** – significant at the 2-% level.

Source: own elaboration.

As for hypothesis 2b, the results do not support it. We can explain this observation applying to investors' strategic intent. Investments in goods decrease risks but simultaneously limit the strategic choice for investors.

Table 4 illustrates the results of testing hypothesis 3, related to the mode of investment.

Table 4. Results by the mode of investments

Project type	CAAR	t Pattel	t-GRANK
Cooperation	0.0087	2.1604*	2.5185**
Special purpose vehicle	0.0633	-0.8973	-0.7219
Sole development	0.1790	0.1766	0.0480

* – significant at the 5-% level; ** – significant at the 2-% level.

Source: own elaboration.

The results accept hypothesis 3 in relation to the investments through cooperation agreements. In this case, the positive response may relate not only to the initiating company that has released an announcement, but also to its possible partners. Thus, the cooperation strengthens the market reaction.

6. Conclusion

We examined the market response to innovation investments at the Russian market. In general, we observe the positive reaction of investors to announcements on companies' innovation projects. It means that investors consider that innovations are able to create value and managers are encouraged to undertake innovation projects. At the closer examination we obtained several interesting findings. The most surprising result of our analysis is the indifferent stock price reaction for industry. This can be explained in that during the period of the study, the whole market was growing and investors' expectations were equally tolerant to innovation in all sectors of the economy. However, this fact requires more examination. Maybe it is reasonable to study the reaction in a longer event window to catch the reaction. The type of a project is important, and due to the strategic approach to innovation investors believe more in research and development investments than in new goods launch at the market. The mode of investments also creates the difference in market responses. Cooperation seems more fruitful, and we register a significant positive response at investments via cooperation agreements.

The study contributes to innovation activities research by its concentration on the idea of studying all of a company's innovation projects within an estimation period together while previous research mainly included a partial analysis of each innovation project of a company. We also tested the statement that in the short-time period the market price change is an appropriate measure of investors' attitude to innovation projects, as was reported by Sood and Tellis (2009). Despite the specifics of Russian market, this idea proved its viability.

This study can also have some practical implications. Managers of enterprises should know what types of investments may cause a positive market reaction and shape innovation activities in a way that suits investors' expectations and creates value. Russian investors value cooperation and research and development investments more than incremental innovation and the sole project development. Managers should optimize their innovation strategies according to these requirements.

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Chapter 9

Investors' Preferences in Polish Stock Market – A Time Series Analysis of Disposition Effect[1]

Magdalena Piechowicz, Małgorzata Snarska

1. Introduction

The collapse of Lehman Brothers in 2008 followed by a sharp decline in liquidity caused plenty of problems in financial sector worldwide. Efficient rational asset valuation mechanism has been disrupted. "Cool heads" were replaced by "hot hearts" and stock market became a hostage to primary emotions – greed and fear. To avoid potential future losses, investors were selling growing companies fast and at the same time, in the hope of gains, they were retaining declining companies longer. This anomaly, called the disposition effect, is a well-documented departure from rational valuation of stocks on mature markets (Odean, 1998).

The main aim of this paper is twofold. Firstly, we will test whether polish capital market is prone or immune to consequences of investment decisions. Secondly, we will try to analyze the disposition effect on the Warsaw Stock Exchange and try to explain it through the prior investors' experiences and preferences by means of AR(1)-TVP-GARCH(1,1)-M model (Wen et al., 2014).

In this framework we will test the following research hypotheses related to the disposition effect:

1. Company's reputation matters in investment decisions. Less known stocks are more likely to be sold quickly, than well-established firms.
2. Investors' sentiment is related to specific economic sectors.
3. Well capitalized firms are less prone to the disposition effect.

The rest of the paper is organized as follows. First we will give a quick insight into theoretical background of disposition effect through prospect function (Kahnemann & Tversky, 1979) and how it can be captured by GARCH(p,q) models with time varying parameters (Wen et al., 2014). Finally, we will describe our dataset and the results of our work.

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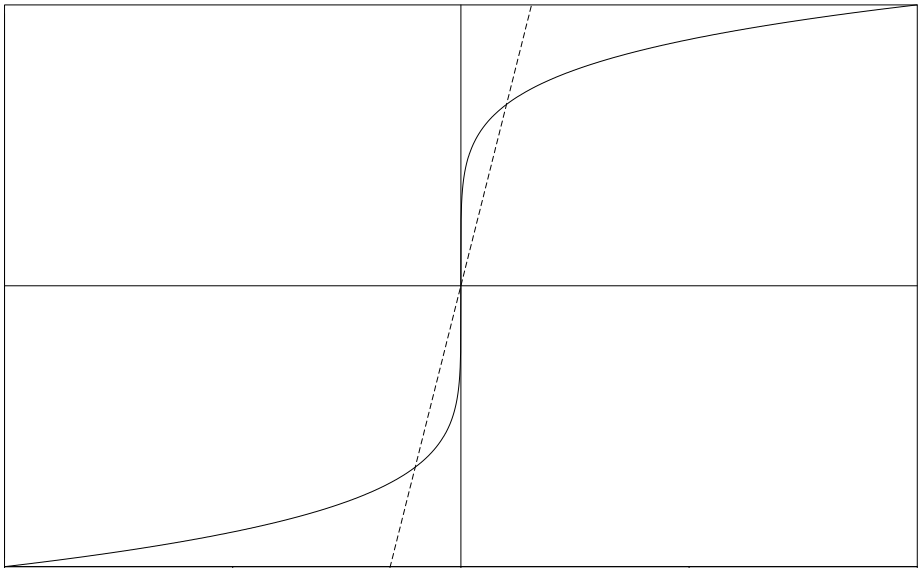
2. Disposition effect in terms of prospect theory and time series models

Prospect theory is a behavioral economic concept describing choices between probabilistic alternatives or lotteries under risk where probabilities of outcomes are not known. Within this framework investors' decisions are based on the potential value of losses and gains rather than the final outcomes. These losses and gains are evaluated on certain heuristics and psychological biases rather than on rational basis (Kahneman & Tversky, 1979).

To explain disposition effect within this set-up we will replace standard utility function with the S-shaped value function (c.f. Fig. 1).

Figure 1. The S – shaped value function (solid) vs standard utility function (dashed)



Source: own elaboration based on (Kahneman & Tversky, 1979).

The value function is steeper for losses than for gains. This means that investors are more reluctant to realize losses than satisfied with gains. This feature is called risk aversion. Furthermore, the shape of value function implies decreasing sensitivity to changes. It is convex below the reference point (for example the purchase price of the stock) and concave above it. It may be justified in practice because investors feel changes near this point much more rather than away from the reference point. As a result, investors will sell their winners more willingly and hold their losses for too long (Wen et al., 2014).

The attributes of the disposition effect under prospect theory can be transformed into the AR(1)-TVP-GARCH(1,1)-M empirical model with conditional normal distribution (Dahlhaus & Rao, 2006; Wen et al., 2014).

$$\begin{cases} r_t = \beta_0 + \beta_1 r_{t-1} + \gamma_t h_t + \varepsilon_t \\ \gamma_t = \eta_0 + \eta_1 \varepsilon_{t-1} \\ h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \theta_1 h_{t-1} \\ \varepsilon_t = \sqrt{h_t} \cdot \nu_t \\ \nu_t \sim \text{iiN}(0,1) \end{cases} \quad (1)$$

where:

r_t – the return rate of the stock,
h_t – the conditional variance,
ε_{t-1} – prior unexpected outcomes,
η_0 – fixed risk compensation demended for each unit,
η_1 – the influence of prior unexpected gains and losses on current risk compensation.

As we can see, return rate is decomposed into such parts: the average return rate $\beta_0 + \beta_1 r_{t-1}$, return rate based on risk compensation $\gamma_t h_t$ and volatility return rate ε_t. Under this assumption we will test $\eta_1 > 0$ as being responsible for the disposition effect (Wen et al., 2014).

3. The analysis of the disposition effect on the polish stock market

3.1. Datasets used

To examine the prevalence of the disposition effect on the stock market in Poland, we have used three distinct datasets, each of them included daily closing prices of selected companies or stock indices. The main source of data is www.stooq.pl. Variables in each sets differ by length – the initial observation covers first public listing and is given in square brackets for each variable separately, while the final observation is set to 27/05/2016.

The choice of stocks and indices is related to research hypotheses:

- Izostal SA (not well-known company) [11/01/11], mBank SA (company with good reputation) [06/10/92],
- 11 sector indices WIG-BANKI [16/04/91], WIG-BUDOW [16/04/91], WIG-CHEMIA [16/04/91], WIG-DEWEL [16/04/91], WIG-ENERG [04/01/10], WIG-INFO [16/04/91], WIG-MEDIA [16/04/91], WIG-PALIWA [16/04/91], WIG-SPOZYW [16/04/91], WIG-SUROWC [28/02/11], WIG-TELKOM [16/04/91],
- Skotan SA (company with low capitalization) [11/01/99], PKN Orlen SA (company with high capitalization) [26/11/99].

3.2. Results of estimation and testing

For every variable in each dataset we have estimated the model (1) with Kalman filter and Quasi Maximum Likelihood method (Dahlhaus and Rao, 2006) using the procedures included in the rugarch R package (Ghalanos, 2015).

Results of the following estimation are presented in Tables 1-15. Disposition effect is related to the location problem of distribution of eta1 parameter and occurs for a particular company or index, when parameter's estimate greater than zero is statistically significant.

Table 1. The results of testing the occurrence the disposition effect for Izostal SA

Param.name	estimate	standard error	t-Student	p-value
beta0	-0.0022528508	1.150255e-03	1.9585668	5.038180e-02
beta1	-0.0067214532	3.322059e-02	0.2023279	8.396927e-01
alpha0	0.0001544611	6.159488e-05	2.5076935	1.227597e-02
alpha1	0.3063965655	1.187476e-01	2.5802334	9.984649e-03
theta1	0.5438001584	1.388852e-01	3.9154643	9.501693e-05
eta0	2.0252731043	2.064296e-01	9.8109606	3.432154e-16
eta1	-1.0151065605	9.069587e+00	-0.1119242	0.54450

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 2. The results of testing the occurrence the disposition effect for mBank SA

Param.name	estimate	standard error	t-Student	p-value
beta0	1.580957e-04	3.614882e-04	0.4373468	6.618764e-01
beta1	2.084689e-02	1.615113e-02	1.2907387	1.968467e-01
alpha0	1.423191e-05	3.030676e-06	4.6959525	2.715904e-06
alpha1	1.300381e-01	1.788400e-02	7.2711994	4.043453e-13
theta1	8.624165e-01	1.397109e-02	61.7286661	0.000000e+00
eta0	8.774975e-01	1.838048e-02	47.7407426	3.504235e-69
eta1	5.871176e+00	7.334216e-01	8.0051852	0.000000e+00

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 3. The results of testing the occurrence the disposition effect for WIG-BANKI

Param.name	estimate	standard error	t-Student	p-value
beta0	1.019451e-04	3.025957e-04	0.336902	7.362029e-01
beta1	1.275006e-01	1.548206e-02	8.235376	2.190754e-16
alpha0	4.704629e-06	3.841878e-06	1.224565	2.207888e-01
alpha1	9.678365e-02	1.978322e-02	4.892209	1.023975e-06
theta1	8.911743e-01	2.482571e-02	35.897235	4.473878e-255
eta0	2.348523e+00	4.033012e-02	58.232477	2.862694e-77
eta1	-1.619915e+01	2.431365e+00	-6.662573	1.000000e+00

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 4. The results of testing the occurrence the disposition effect for WIG-BUDOW

Param.name	estimate	standard error	t-Student	p-value
beta0	-1.668450e-04	2.961803e-04	0.5633226	5.732370e-01
beta1	1.540028e-01	1.659403e-02	9.2806148	2.328036e-20
alpha0	4.317331e-06	5.942260e-06	0.7265470	4.675327e-01
alpha1	1.111497e-01	4.097948e-02	2.7123260	6.700949e-03
theta1	8.785166e-01	4.974503e-02	17.6603890	4.935988e-68
eta0	3.482016e+00	6.481577e-02	53.7217364	5.649839e-74
eta1	-2.780205e+01	5.338842e+00	-5.2075052	1.000000e+00

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 5. The results of testing the occurrence the disposition effect for WIG-CHEMIA

Param.name	**estimate**	**standard error**	**t-Student**	**p-value**
beta0	5.582755e-04	3.100350e-04	1.800686	7.180425e-02
beta1	1.386573e-01	1.442200e-02	9.614284	1.008971e-21
alpha0	5.852912e-06	3.633170e-06	1.610965	1.072416e-01
alpha1	1.129988e-01	1.234395e-02	9.154189	7.439240e-20
theta1	8.709089e-01	1.805977e-02	48.223683	0.000000e+00
eta0	2.021860e+00	3.801091e-02	53.191572	1.433038e-73
eta1	-2.021968e+01	2.556848e+00	-7.908051	1.000000e+00

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 6. The results of testing the occurrence the disposition effect for WIG-DEWEL

Param.name	**estimate**	**standard error**	**t-Student**	**p-value**
beta0	2.930814e-04	0.0005384401	0.544315788	5.862451e-01
beta1	1.293824e-01	0.4003226958	0.323195260	7.465590e-01
alpha0	2.459274e-06	0.0005104041	0.004818289	9.961557e-01
alpha1	9.130170e-02	4.8551446338	0.018805146	9.849972e-01
theta1	9.034000e-01	4.9779567662	0.181480081	8.559971e-01
eta0	1.329965e+00	0.0417732095	31.837746306	3.757896e-53
eta1	7.889155e-01	4.4323565460	0.177990083	0.42946

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 7. The results of testing the occurrence the disposition effect for WIG-ENERG

Param.name	**estimate**	**standard error**	**t-Student**	**p-value**
beta0	9.571375e-05	9.372901e-04	0.10211753	9.186763e-01
beta1	-1.516683e-02	2.746032e-02	0.55231813	5.808085e-01
alpha0	2.469435e-06	3.800869e-05	0.06497027	9.482059e-01
alpha1	7.155929e-02	3.415801e-01	0.20949490	8.340889e-01
theta1	9.154540e-01	4.026014e-01	2.27384698	2.310874e-02
eta0	7.945820e-01	1.464863e-01	5.42427634	4.270393e-07
eta1	-2.445283e+00	8.391844e+00	-0.29138807	0.61447

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 8. The results of testing the occurrence the disposition effect for WIG-INFO

Param.name	estimate	standard error	t-Student	p-value
beta0	0.0003422719	2.752662e-04	1.2434214	2.137627e-01
beta1	0.1023282971	1.729858e-02	5.9154171	3.498979e-09
alpha0	0.0000044402	4.885671e-06	0.9088209	3.634823e-01
alpha1	0.1118374256	3.466016e-02	3.2266850	1.259274e-03
theta1	0.8810393113	3.897911e-02	22.6028608	1.713923e-108
eta0	0.8946939605	2.912645e-02	30.7175737	8.892384e-52
eta1	4.8804023976	2.464526e+00	1.9802600	0.02452

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 9. The results of testing the occurrence the disposition effect for WIG-MEDIA

Param.name	estimate	standard error	t-Student	p-value
beta0	-2.041489e-05	3.155947e-04	0.06468705	9.484254e-01
beta1	1.179567e-01	1.560640e-02	7.55823036	4.720117e-14
alpha0	5.504933e-06	4.398728e-06	1.25148301	2.108087e-01
alpha1	1.001305e-01	1.567074e-02	6.38964827	1.791847e-10
theta1	8.839332e-01	2.382625e-02	37.09913775	1.381095e-270
eta0	3.012830e+00	2.963080e-02	101.67897979	2.342748e-100
eta1	-2.208368e+01	1.733511e+00	-12.73927543	1.000000e+00

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 10. The results of testing the occurrence the disposition effect for WIG-PALIWA

Param.name	estimate	standard error	t-Student	p-value
beta0	4.556893e-04	0.0014600048	0.312114923	7.549644e-01
beta1	9.434067e-02	0.3376720652	0.279385485	7.799589e-01
alpha0	3.300759e-06	0.0006162658	0.005356063	9.957267e-01
alpha1	8.543913e-02	4.4867884295	0.019042381	9.848080e-01
theta1	9.075201e-01	4.9377228279	0.183793251	8.541821e-01
eta0	6.287999e-01	0.0533959382	11.776174258	2.091721e-20
eta1	2.349014e+01	3.3386772172	7.035763823	0.000000e+00

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 11. The results of testing the occurrence the disposition effect for WIG-SPOZYW

Param.name	estimate	standard error	t-Student	p-value
beta0	2.854461e-04	2.420805e-04	1.179137	2.383917e-01
beta1	1.318117e-01	1.730846e-02	7.615452	3.048751e-14
alpha0	4.941803e-06	4.626561e-06	1.068137	2.855029e-01
alpha1	1.681703e-01	3.049309e-02	5.515028	3.637631e-08
theta1	8.308282e-01	3.759990e-02	22.096552	5.868159e-104
eta0	1.913779e+00	3.150168e-02	60.751660	5.245778e-79
eta1	-6.651591e+00	1.985876e+00	-3.349449	0.99952

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 12. The results of testing the occurrence the disposition effect for WIG-SUROWC

Param.name	estimation	standard error	t-Student	p-value
beta0	-7.157106e-04	1.209920e-03	0.5915353	5.542656e-01
beta1	5.917037e-02	2.636726e-02	2.2440846	2.499611e-02
alpha0	6.618910e-06	1.833459e-05	0.3610067	7.181536e-01
alpha1	6.286184e-02	4.356336e-02	1.4429979	1.492640e-01
theta1	9.229540e-01	2.034971e-02	45.3546545	2.814906e-269
eta0	4.464221e+00	3.509979e-01	12.7186546	2.184897e-22
eta1	-7.095035e+01	1.340331e+01	-5.2934932	1.000000e+00

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 13. The results of testing the occurrence the disposition effect for WIG-TELKOM

Param.name	estimate	standard error	t-Student	p-value
beta0	1.849928e-04	2.920871e-04	0.6333479	5.265314e-01
beta1	8.153403e-02	1.673941e-02	4.8707820	1.141020e-06
alpha0	7.935123e-06	4.217076e-06	1.8816649	5.993145e-02
alpha1	1.233069e-01	1.559738e-02	7.9056174	3.166785e-15
theta1	8.652363e-01	1.780723e-02	48.5890468	0.000000e+00
eta0	5.949016e-01	2.928987e-02	20.3108306	1.030312e-36
eta1	3.570403e+00	1.913718e+00	1.8656889	0.03177

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 14. The results of testing the occurrence the disposition effect for Skotan SA

Param.name	estimate	standard error	t-Student	p-value
beta0	-0.0026320530	0.0005607856	4.693510	2.774036e-06
beta1	-0.0608110027	0.0179452093	3.388704	7.089226e-04
alpha0	0.0002004123	0.0000869539	2.304811	2.122733e-02
alpha1	0.2897145036	0.0616833284	4.696804	2.729929e-06
theta1	0.7092854645	0.0762208652	9.305660	2.120900e-20
eta0	0.2253357972	0.0026356406	85.495646	3.912201e-93
eta1	-0.3308189862	0.0546288066	-6.055761	1.000000e+00

Source: own calculations in R. Data were downloaded from stooq.pl.

Table 15. The results of testing the occurrence the disposition effect for PKN Orlen SA

Param.name	estimate	standard error	t-Student	p-value
beta0	9.188955e-04	0.0007571721	1.21358868	2.249745e-01
beta1	4.728668e-04	0.0162143796	0.02916342	9.767357e-01
alpha0	8.579361e-06	0.0000011133	7.70624221	1.613715e-14
alpha1	4.473914e-02	0.0025773504	17.35857871	3.398030e-65
theta1	9.355307e-01	0.0037074497	252.33806260	0.000000e+00
eta0	-1.528936e+00	0.0906066010	-16.87444909	1.293958e-30
eta1	1.547774e+01	4.7054430234	3.28932785	0.00059

Source: own calculations in R. Data were downloaded from stooq.pl.

When it comes to company's reputation, the parameter is statistically significant for mBank SA, which means that investors make decisions about funds allocation on basis of company's seniority.

The influence of prior unexpected gains and losses has been noticed for 3 from 11 sectors as follows: information, petroleum and telecommunications.

Finally, the null hypothesis cannot be rejected for Skotan SA (the company with thin capitalization). The research study has proved that the size of a company determines the existence of the disposition effect on Polish Stock Market.

4. Conclusion

In this paper we have tested the existence of disposition effect on polish capital market. For the purpose of our study we have estimated AR(1)-TVP-GARCH(1,1)-M empirical model with conditional normal distribution for every variable from three distinct datasets.

Our results generally confirm that disposition effect is an anomaly, that is also present in emerging or not fully developed markets. There are however sectors, that are more immune to past investor's outcomes than other ones.

Well known and respected companies are actually more prone to this heuristic. In fear of loss investors are more willing to sell quickly well recognized (and more liquid) stocks, than less known firms. Similar situation happens also with highly capitalized stocks. Investors realize gains more willingly.

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Chapter 10

Diamonds as Safe Assets – Price Discovery between Equity and Diamond Markets[1]

Jakub Piłka, Małgorzata Snarska

1. Introduction

Diamonds are forever. Diamond prices have been rising continuously for many years with dynamics, that exceeds changes of inflation. Potential investor can also benefit from physical attributes of diamonds. Diamonds thanks to its hardness (10 out of 10 on the Mohs scale) are resistant to destruction in case of natural disasters or war (Renneboog & Spaenjers, 2012).

The main aim of this paper is to test whether diamonds can be treated as safe assets i.e. provide capital protection and are also profitable investment in volatile market condition (Caballero & Farhi, 2013). Within this framework we will make an attempt to empirically analyze the price discovery process on diamond markets i.e. the price formation on diamond markets influenced by impulses coming from stock or equity market (Narayan & Smith, 2015).

The rest of the paper is organized as follows. First we will focus on diamonds, their features and briefly recap safe asset mechanism (Caballero & Farhi, 2013). Next we will construct empirical test for price discovery process based on Granger causality (Granger, 1969) and present results of our analysis on real data.

The study uses daily levels of index closing prices of diamonds IDEX and closing levels of the S&P500 index of the period from 01/07/2004 to 21/04/2016. The test data sample is divided into two periods following the results of structural change tests (Bai & Perron, 1998). We perform Granger causality tests in each period separately.

2. Diamonds as safe assets

Empirical price discovery mechanism can be characterized in two separate regimes – before and during crisis. In the period before crisis, stock market and diamonds' market are not linked. Fluctuations in the stock market have no effect on the price fluctuations of diamonds. Therefore,

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in times of crisis, diamonds can be an appropriate capital protection (Low et al., 2016). After the collapse of Lehman Brothers stock price movements affect diamond price changes and investment in diamonds can bring additional surplus rate of return – premium (Baur & Lucey, 2010; Low et al., 2016).

2.1. Diamonds and their attributes

Investment in diamonds means investment in polished stones, that are characterized by the color-clarity-cut-carat weight principle (Low et al., 2016; Baur & Lucey, 2010).

Diamonds are scarce assets, that hypnotize investor with blaze of fire and astonishing colors. Despite intensive exploration of resources one projects a decline in diamond supply by about 1-2% per year and demand for investment diamonds is going to grow by about 3-4% per year. This gap between supply and demand results in increase of diamonds value. Diamonds thus allow to transport large amounts of capital without costs of carry.

On the other hand however diamonds (gr. adamas – undefeated) are also regular allotropic kind of carbon and most durable mineral in the world. Thanks to its hardness (10 out of 10 on the Mohs scale) diamonds are resistant to destruction during natural disasters or wars. Unlike common stock, diamonds are physical goods, whose prices are rising constantly and profits are not virtual (Renneboog & Spaenjers, 2012).

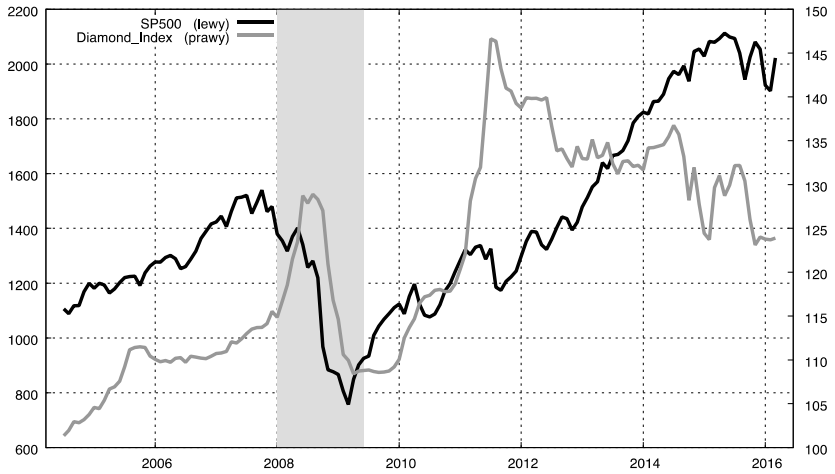
Thanks to its physical form and characteristics and established the value of the diamonds are a universal means of payment independent of inflation and currency fluctuations. These characteristics make diamond assets safe or safe haven (Low et al., 2016; Baur & Lucey, 2010).

2.2. Diamond markets and stock markets

Prior to Lehmann Bank collapse in 2008 diamond prices have been steadily rising. The dynamics of price growth was even faster than an analogous increase in the value of US stock market (Renneboog & Spaenjers, 2012).

In 2008, diamond prices plummeted due to lower demand for investment goods (Fig. 1). In the same period, the World Federation of Diamond Bourses (WFDB) decided to reduce diamond production. As a result, at the end of 2011, diamond prices have risen sharply again and were then reduced to stable levels due to WFDB activity (Low et al., 2016).

Figure 1. Diamond and S&P500 equity index prices (monthly averages)



Source: own work in R. Data were obtained directly from IDEX Online and NYSE.

2.3. Safe asset mechanims

As stated in previous section investment diamonds possess enough adequacy to become safe assets or safe havens in periods of crisis in equity markets (Renneboog & Spaenjers, 2012). In this section we will briefly review safe asset mechanism (Caballero & Farhi, 2013).

We start with an assumption that an economy consists of two goods only – namely: diamonds and stocks. Diamond prices X are generally constant until a shock from equity market appears. As a result diamond values lowers to $\mu X < X$. At this point we will make a proposition without proof, that frequency of equity shocks can be described by Poisson process with $\lambda \to 0$.

Investors in this economy can allocate their funds for infinitely long time, because each investor can be replaced by next generation of descendants who inherits all wealth. Here the ratio of births to deaths is described by θ. Then total consumption of all goods is a fraction of total wealth W_t, meaning:

$$C_t = \theta W_t \tag{1}$$

If market is in its equilibrium state, then:

$$W_t = \frac{X}{\theta} \tag{2}$$

Demand for stocks and diamonds is reported by two groups of investors – risk averse and risk neutral. Risk averse investors make their decisions as if a negative shock in equity markets will happen very soon with probability equal to 1.

We will describe total value of wealth of both groups by:

$$W_t^{\alpha} + W_t^{1-\alpha} = W_t \tag{3}$$

On the supply side we will assume, that a fraction of excavated diamonds δ is going to be treated as collateral, while the rest $(1-\delta)X$ is traded on the market.

Supply of risky V^r and safe assets V^s before equity shock can be described by:

$$V = V^r + V^s = W_t = \frac{X}{\theta} \tag{4}$$

After shock we can describe assets traded ρ as:

$$V^s = \frac{\rho(1-\delta)X}{\theta} \tag{5}$$

$$V^r = \frac{\left(1-\rho(1-\delta)\right)X}{\theta}$$

The market equilibrium implies that:

$$\begin{cases} r^s V^S = \delta^s X \\ r V^r = \left(\delta - \delta^s\right) X \\ \dfrac{dW_t^{\alpha}}{dt} = -\theta W_t^{\alpha} + \alpha\left(1-\delta\right)X + r^S W_t^{\alpha} \\ \dfrac{dW_t^{(1-\alpha)}}{dt} = -\theta W_t^{1-\alpha} + \left(1-\alpha\right)\left(1-\delta\right)X + r W_t^{1-\alpha} \\ W_t^{\alpha} + W_t^{1-\alpha} = V^s + V^r \end{cases} \tag{6}$$

where:

r^S – safe asset return,

r – risk asset return,

δ^s – dividend from investing in risky assets.

3. Empirical test of price discovery mechanism

Empirical test of the phenomenon of price discovery mechanism on diamond markets under the influence of impulses from the stock market can now be reduced to the Granger causality analysis (Narayan & Smyth, 2015).

3.1. Causality concept

Causality in the broad sense (immediate causality) can be understood literally as the direct relationship between events. If the event (factor) X implies (determines) occurrence of the event Y, then we say that X causes Y.

Causality in Granger sense is, however, subject to additional conditions. There are three axioms underlying this concept.

1. Past and present may result in the future, but the future may not cause the past.

2. Ωt (total knowledge available in the universe at time t) does not contain unnecessary information, i.e. if a variable Zt is operatively associated with one or more other variables in a deterministic way, Zt should be excluded from Ωt.
3. All the causal relationships have a fixed direction regardless of the passage of time

In the case of two time series *X* and *Y* one can understand this concept of causality as precedence (Granger, 1969)

$$P(X_{t+1} \in A \mid X,Y) \neq P(X_{t+1} \in A \mid X) \tag{7}$$

where:
X,*Y* – historical observations of time series,
X_{t+1} – values of *X* at *t*+1.

Granger causality usually occurs in econometrics when in construction of a model for *Y*, the explanatory variable can be more accurately predicted by using delayed values of variable *X*.

3.2. Standard test

Standard Granger causality test from r vars package (Pfaff, 2008) requires original data to be stationary, so we will construct the following empirical model (VAR(p))

$$\begin{cases} \mathrm{y_t} = \alpha_1 + \sum_{j=1}^{p} \beta_{1j} y_{t-j} + \sum_{j=1}^{p} \gamma_{1j} \mathrm{x_{t\text{-}j}} + \varepsilon_{1t} \\ \mathrm{x_t} = \alpha_2 + \sum_{j=1}^{p} \beta_{2j} y_{t-j} + \sum_{j=1}^{p} \gamma_{2j} \mathrm{x_{t\text{-}j}} + \varepsilon_{2t} \end{cases} \tag{8}$$

where:
$\mathrm{y_t}$,$\mathrm{x_t}$ – variables being tested.

To choose appropriate length p for VAR model we will use Bayesian information criterion

$$BIC(\theta, p) = 2\log\left[L(\theta, p)\right] - k \cdot log(T) \tag{9}$$

where:
$L(\theta)$ – likelihood function,
k – number of estimated parameters,
T – length of time series sample.

If variables are cointegrated of order CI(1,1), model (8) has to modified to include error correction terms.

$$\begin{cases} \Delta \mathrm{y_t} = \alpha_1 + \sum_{j=1}^{p} \beta_{1j} \Delta y_{t-j} + \sum_{j=1}^{p} \gamma_{1p} \Delta \mathrm{x_{t-p}} + \lambda_1 \ \mathrm{ECM_{t-1}} + \varepsilon_{1t} \\ \Delta \mathrm{x_t} = \alpha_2 + \sum_{j=1}^{p} \beta_{2j} \Delta y_{t-j} + \sum_{j=1}^{p} \gamma_{2p} \Delta \mathrm{x_{t-p}} + \lambda_2 \ \mathrm{ECM_{t-1}} + \varepsilon_{2t} \end{cases} \tag{10}$$

where:
$\Delta \mathrm{x_t}$, Δy_t – stationary variables,
$\mathrm{ECM_{t-1}}$ – exogenous variable representing the error correction term.

Now our empirical test of price discovery is related to the following set of hypotheses and F – statistic (Koop, 2014).

$$\begin{aligned} H_0 &: \gamma_{11} = \gamma_{12} = \ldots = \gamma_{1p} = 0 \\ H_1 &: \gamma_{11} \neq 0 \; or \; \gamma_{12} \neq 0 \ldots or \; \gamma_{1p} \neq 0 \end{aligned} \tag{11}$$

and equivalently:

$$\begin{aligned} H_0 &: \beta_{21} = \beta_{22} = \ldots = \beta_{2p} = 0 \\ H_1 &: \beta_{21} \neq 0 \; or \; \beta_{22} \neq 0 \ldots or \; \beta_{2p} \neq 0 \end{aligned} \tag{12}$$

4. Empirical results

4.1. Description of dataset

To study the mechanism of price discovery of diamonds between the market and the market shares of selected index closing levels of the S&P500, downloaded from the portal stooq.pl and quotations of investment diamonds – made available by the IDEX – the international body monitoring prices of investment diamonds in the world with the period from 07.01.2004 till 21.04. 2016. Daily prices and S&P500 index were averaged on a monthly basis and tested for stationarity (c.f. Tab. 1).

Table 1. Descriptive statistics of dataset

	Mean	**Sd**	**Skewness**	**Kurtosis**
SP500	1416	338.83	0.59489	-0.49901
ld_SP500	0.0043068	0.038526	-1.9537	9.3778
Diamond_Index	121.57	11.815	0.16291	-1.2761
ld_Diamond_Index	0.0014352	0.015554	0.23154	2.6851
	ADF	p-value	lags	Integration order
SP500	0.854238	0.8945	6	I(1)
ld_SP500	-4.6063	4.70E-06	5	I(0)

Source: own calculations in R. Data were downloaded from IDEX Online and NYSE.

Since the analyzed variables are integrated of the first analysis was performed cointegration. To identify the number of cointegrating relationships we will use a Johansen procedure. In all cases, we have adopted the specifications of error correction model without intercept. The number of selected delays based on the analysis of the autocorrelation function once differentiated processes. The results are summarized in Table 2.

Table 2. The results of cointegration testing in the identified sub-periods

2004/07-2008/09 (max significant lag: 2)					
No of coint. relations	**Eigenvalue**	**Trace test**	**p-value**	**Max eigenvalue test**	**p-value**
0	0.1656	8.9432	0.1734	8.8713	0.1277
1	0.001468	0.071984	0.85	0.071984	0.8414
2008/09-2016/04 (max significant lag: 6)					
No of coint. relations	**Eigenvalue**	**Trace test**	**p-value**	**Max eigenvalue test**	**p-value**
0	0.035202	3.553	0.7643	3.2253	0.7487
1	0.0036351	0.32775	0.639	0.32775	0.6303

Source: own calculations in R. Data were downloaded from IDEX Online and NYSE.

For adopted the significance level of 0.01, according to the Johansen test, the variables do not show the existence of long-term linear equilibrium relationship.

4.2. Testing for price discovery between equity and diamond markets

The next step in our procedure for price discovery analysis is Granger causality test testing The test results are summarized in Tables 3 and 4.

Table 3. Estimation results for Diamond and Equity markets price discovery

Period	**Y**	**X**	**Estimate**	**S.e.**	**Student t**	**p-value**	**DW**
2004/07-2008/09	$\Delta \ln SP500_t$	$\Delta \ln SP500_{t-1}$	0.0168656	0.115246	0.1463	0.8843	1.82972
		$\Delta \ln Diam_{t-1}$	−0.713978	0.488386	−1.462	0.1504	
	$\Delta \ln Diam_t$	$\Delta \ln SP500_{t-1}$	−0.0229262	0.0675448	−0.3394	0.7358	2.287591
		$\Delta \ln Diam_{t-1}$	0.399959	0.219719	1.82	0.0751	
2008/10-2016/04	$\Delta \ln SP500_t$	$\Delta \ln SP500_{t-1}$	0.274151	0.0718464	3.816	0.0003	2.051476
		$\Delta \ln Diam_{t-1}$	−0.208943	0.219602	−0.9515	0.344	
	$\Delta \ln Diam_t$	$\Delta \ln SP500_{t-1}$	0.101194	0.0450109	2.248	0.0271	2.067504
		$\Delta \ln Diam_{t-1}$	0.34741	0.115075	3.019	0.0033	

Source: own calculations in R. Data were downloaded from IDEX Online and NYSE.

Table 4. Granger causality tests

2004/07-2008/09			
variable	**source**	**F statistic**	**p-value**
SP 500	diamonds	2.1372	0.1504
diamonds	SP500	0.11521	0.7358
2008/10-2016/04			
variable	**source**	**F statistic**	**p-value**
SP 500	diamonds	0.90529	0.344
diamonds	SP500	5.0544	0.0271

Source: own calculations in R. Data were downloaded from IDEX Online and NYSE.

In the second considered period, i.e. after the collapse of Lehman Brothers price fluctuations in the stock market had an impact on price fluctuations in the market of investment diamonds. The existence of a cause – effect relationship in the sense of Granger in the period after the crisis had been proved.

In the next stage, in order to establish causality immediate estimated model Sharpe (1971). Due to the autocorrelation of random components, used UMNRL – regression corrected for autocorrelation Cochrane – Orcutt (Narayan & Smyth, 2015). The estimation results are summarized in Table 5.

Table 5. Testing for premium on diamond markets

Period	Y	X	Estimate	S.e.	Student t	P -value	DW
2004/07-2008/09	$\Delta \ln Diam_t$	Const	0.00455608	0.00167378	2.722	0.0091	2.141336
		$\Delta \ln SP500_t$	0.0304582	0.0427209	0.713	0.4794	
2008/10-2016/04	$\Delta \ln Diam_t$	Const	−0.000317362	0.00289983	−0.1094	0.9131	1.908497
		$\Delta \ln SP500_t$	0.011107	0.0526346	0.211	0.8334	

Source: own calculations in R. Data were downloaded from IDEX Online and NYSE.

Analysis of the results of the Table 5 does not allow us to reject the hypothesis that the dynamics of stock prices and the diamonds are not linked directly a cause – effect relationship.

5. Conclusion

In the light of the results we can say that diamonds markets and equity markets are not linked long-term equilibrium relationship. In the short term there was also no immediate causal relationship between the dynamics of prices on both markets, however investors in the period before the collapse of Lehman Brothers could obtain statistically significant surplus on a diamond market compared to an investment in equties.

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Chapter 11

Company Borrowing in International Financial Market through Direct Financing

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1. Introduction

In the modern business environment, companies are facing strong competition, which forces them to invest in new plants and new equipment. These investments generally exceed the accumulated funds from the profit which company makes, so companies are forced to be indebted or to sell part of the property by issuance of shares. Like most of the developing countries, Serbia is characterized by a financial system in which the corporate sector mainly uses bank loans. In such systems, the financial system of direct financing of companies is very rarely used. However, encouraging the financing of private businesses by issuing debt securities would not mean reducing the role of the banks, it would mean the diversification of their business. If the strengthening of debt securities market partially caused the reduction of the role of credit operations of commercial banks, it would lead to the development of banking services related to the investment banking as well.

In this paper, we are analyzing the commercial papers and corporate bonds as two basic types of debt securities, which may be issued and sold by the companies directly to investors. In this way, without the mediation of banks they get indebted in the financial market. The aim of the research is to show the importance of these financial instruments, bearing in mind that, in developed markets, they are an important source of financing for the companies.

2. Commercial papers

Commercial papers, in developed financial markets are an important source of financing for companies (Kahl et al., 2008). Funds gained in this way are used to finance current obligations (paying taxes, paying rent, payment of salaries and other short-term funding commitments), but not for long-term financing of capital investments (Rose & Marquis, 2011, p. 342). However, sometimes commercial papers can be issued for the purpose of overcoming any possible short-term financial difficulties in long-term investments (Kahl et al., 2008). In such situations, there is a risk of moral hazard, so this purpose should be avoided.

Commercial paper is a form of unsecured debt, which usually has an original maturity of 3 to 270 days (i.e. weekend paper), except in the United States, where the most common maturity is that of 30 days (Fabozzi, 2013, p. 167). Maturity does not exceed 270 days, because with that, the obligation of registration of emission at the SEC is avoided.

The most important buyers of commercial papers are funds of money markets, insurance companies, mutual funds, pension funds, states and local governments, brokers and dealers of securities and foreign investors (Kahl et al., 2008). Commercial banks were the first buyers of commercial papers in the US, while today, the biggest buyers are open investment funds of money markets, or mutual funds (Fabozzi, 2013, p. 167).

Commercial papers are most commonly issued by issuers with the highest credit rating or low credit risk (Rose, 1999, p. 314). For such companies, getting indebted by the issuance of commercial papers is a cheaper source of funding, compared to credit lines from banks (Kahl et al., 2008). Therefore, banks are forced to reduce interest rates for their best customers (Brealey et al., 2009, p. 529).

If the commercial papers are issued on the Euromarket, they are called Eurocommercial papers (Europapers). In the Euromarket, they are issued by a smaller number of non-financial companies of excellent creditworthiness, and distribution services for them are provided with the best known investment firms (Merrill Lynch, Goldman Sachs et al.) (Jakšić, 2011, p. 93). Europapers generally have longer maturities and higher interest rates than US commercial papers, due to their presumed greater credit risk. Also, compared to US commercial papers, Europapers have more active secondary market (Rose, 1999, p. 314).

In the past, there were no significant manipulations and frauds in the market for commercial papers. The literature often mentions only the case of Penn Central Transportation Company, which in 1970 did not carry out the obligations arising from the issued commercial papers in the amount of 82 million USD. This case represented an exception, but it was enough to get started with rating of these securities by specialized companies such as Moody's Investor Service, Standard & Poor's and Fitch Corporations Investor Service, which is shown in the Table 1.

Table 1. Rating of commercial papers

Category	Fitch	Moody' s	S&P
Investment grade	F-1+		A-1+
	F-1	P-1	A-1
	F-2	P-2	A-2
	F-3	P-3	A-3
Noninvestment grade	F-S	NP (not prime)	B
			C
In default	D		D

Source: (Fabozzi, 2013, p. 168).

Moody agency assigns rating of Prime-1 (P-1), for the paper of the highest quality, and then for the emissions of lower quality rating of Prime-2 or Prime-3. Standard & Poor agency assigns a credit rating of A-1 + and A-1, A-2 and A-3, while Fitch agency uses the F-1, F-2 and F-3 (with modifier + with F-1 where the rating justifies this). Each program ranked below the P-2, A-2 and F-2 in most cases is difficult to sell or cannot be sold (Rose & Marquis, 2011, p. 350).

Financial companies and bank holding companies sell commercial papers through dealers or directly, while non-financial companies sell only through dealers. Among the leading financial companies which sell this type of securities directly to investors we include General Motors Acceptance Corporation, General Electric Capital Corporation, CIT Financial Corporation and Commercial Credit Corporation (Rose & Marquis, 2011, p. 342). Leading dealers of commercial transactions in the USA are Citicorp (Citigroup), Credit-Suisse, Morgan Stanley and Bank of America (Rose & Marquis, 2011, p. 350).

Based on the data contained in Table 2 it can be seen that the commercial papers during the observed period are one of the financial instruments of the money market, which has achieved the highest growth (Mishkin, 2007, p. 255). So, many companies that had previously practiced taking short-term loans from banks began to obtain short-term funds in the commercial papers. In the early 1980s, the use of commercial papers had increased significantly as a result of the rising cost of bank loans. The amount outstanding of commercial paper increased in the period from 1980 to 2005 to over 1200%, from 122 to 1,640 billion USD (Mishkin, 2007, p. 28).

Table 2. Basic instruments of money market in the United States in the period 1980-2015

Type of instrument	**The amount outstanding in the billions of dollars at the end of a year**				
	1980	**1990**	**2000**	**2005**	**2015**
Treasury bills	216	527	647	923	1511
Negotiable certificates of deposit (large denomination)	317	543	1053	1742	1865
Commercial papers	122	557	1619	1640	941.5
Bank acceptances	42	52	8	4	0
Repurchase agreements	57	144	366	518	712
Federal funds	18	61	60	83	65

Source: (Mishkin, 2007, p. 28; www.federalreserve.gov).

If the analysis is extended to a period of 50 years and we consider only the issuance of commercial papers (Tab. 3) the enormous growth of these types of securities can also be observed.

Table 3. Commercial papers issuance in the USA in the period from 1960 to 2015

Year	**The amount of issued papers in the billions of dollars**
1960	4,5
1970	33,1
1980	121,6
1990	557,8
2000	1.619,1
2006	1.957,5
2010	1. 057,5
2015	941.5

Source: (Rose & Marquis, 2011, p. 344; www.federalreserve.gov).

The highest level of commercial papers outstanding was achieved in 2006, when the amount outstanding was 1.957,5 billions of dollars. Contrary to a very active primary market, secondary trading of these securities is underdeveloped (Downing & Oliner, 2004).

In Table 4, we compared commercial papers to other instruments of money market in the United States in terms of return on instruments.

Table 4. Money Market Instruments comparison in 1990 and 2010

Money Market Instruments	Rate of Return	
	1990	2010
Treasury bills	6.68	0.16
Federal funds and repurchase agreements	7.31	0.20
Commercial paper	8.14	0.43
Negotiable certificates of deposit	8.13	0.53
Banker s acceptances	7.95	0.55

Source: (Saunders & Cornett, 2012, p. 147).

Based on Table 4, it can be concluded that the commercial papers are seen as very attractive instrument for investors. At the end of 1990 they had a higher rate of return compared to other instruments on the money market. Also, at the end of 2010, with the banking acceptances and negotiable certificates of deposit, they brought a higher rate of return compared to other instruments. However, it is important to note that the rates of return on all instruments on the money market in 2010 are significantly less than in 1990. Based on the data contained in Table 5 it can be seen that the commercial papers became a significant alternative to bank loans, primarily due to lower cost of debt.

Table 5. The difference between the average primary rate offered by major US banks and the rate on three-month commercial papers

Year	Bank's primary rate	Rate of three-month commercial papers	The interest rate spread in percentage points
1998	8.35	5.34	3.01
2000	9.23	6.31	2.92
2002	4.67	1.69	2.98
2004	4.34	1.41	2.93
2006	7.96	5.10	2.86
2008	5.09	2.13	2.96
2009*	3.25	1.11	2.14

* numbers for 2009. are for November

Source: (Rose & Marquis, 2011, p. 347).

There are many reasons for the increase in the use of commercial papers, but the dominant ones were: firstly, many investors consider commercial papers a good substitute for treasury bills and other instruments of money markets. Secondly, for the big and well-known companies

commercial paper is a very good substitute for bank loan and other forms of borrowing (Rose & Marquis, 2011, p. 344).

3. The use of commercial papers in Serbia

In the money market in Serbia, commercial bills represented a popular security during the late nineties because in this period, there were practically no bank loans, or if there were any, they were very expensive. However, in that period, the creditworthiness of the issuer and the degree of indebtedness was not taken into account in a proper way, hence, several problems emerged. They were primarily related to the non-fulfillment of commitments on that basis. In early 2003, the Commission for Securities introduced a new procedure for recording the issues of these securities, with obligatory to acquisition of the opinion of the creditworthiness of the National Bank of Serbia. The aim was to protect investors through the provision of relevant information on the issuers of these securities. Since 2004, commercial papers have not been present in the money markets of Serbia (Kočović & Jovovic, 2010, p. 85). Currently, there is insufficient legal certainty when it comes to the issuance and trading of commercial paper as well as money market instruments, which is reflected in the undefined obligation for subscription and registration of these instruments and indeterminate way of trading these instruments in the money market. Due to the lack of clarity whether this money market instruments must be subscribed and registered with the Central Depository and Clearing House of Belgrade, and whether the trading of these instruments is implemented through investment companies, the issuers are left to arrange their own relationship with potential investors which would, in this case, be governed by the Law of Obligations. In addition, money market instruments as well as commercial papers have the possibility of appearing in a materialized form. Currently, Serbia does not have issued commercial papers.

4. Corporate bonds

A corporate bond can be defined as a financial instrument issued by companies, or corporations, which binds them to, in a previously defined term, on the due date, pay for the defined coupon, as well as the principal, at maturity of said bond. Also, it can be seen as a contract based on which investors loan money to a company which is then bound to pay interest to the bondholders in successive time periods and pay the nominal value of the bond at maturity (Cecchetti & Schoenholtz, 2011, p. 167). Liquidity, that is, the possibility to buy and sell corporate bonds in the secondary market increases their appeal and ensures their owners to obtain cash before their maturity date[1]. Corporate bonds in developed financial markets have long-term maturity. Even at the beginning of the XX century in the US market, there were corporate railway bonds with maturity of more than 100 years. During the 1950s and 1960s, maturity was quite shorter and corporate bonds with maturity of 20, 30 and 40 years were dominant. This trend continued during the 1970s and 1980s and, due to a sudden inflation and high interest rates, only corporate bonds with maturity of 5 to 15 years were present in the market (Rose & Marquis, 2011, p. 628). Controlled inflation and quite low interest rates at the beginning of the 1990s contributed to an enormous increase in the maturity of these securities. In that period companies such

[1] Read more at: http://www.jorgicbroker.co.rs.

as *Walt Disney* and *Coca Cola* managed to invest bonds with maturity of 100 years to the market (Marinković, 2011, p. 117). Bonds with such long-term maturity most commonly enable its issuer to redeem them after 30 years (Jakšić, 2005, p. 231). Also, a buyer can convert corporate bonds to other types of securities (other bonds or stocks of the same company). These are the so-called convertible bonds which play a significant role in the European bond market (most commonly found in Great Britan, France and Italy).

US corporate bonds are mostly traded through dealers, or market makers, on over-the-counter exchanges, and only a small number of these bonds is found in the listing of the New York Stock Exchange (NYSE). Those are bonds issued by large corporations. It is quite easy for companies such as *Ford*, *IBM* or *General Electric*, to issue bonds and in that way obtain necessary financial resources (Cecchetti & Schoenholtz, 2011, p. 167). However, the range of the secondary trade in corporate bonds is at a low level, even when it comes to the highest quality companies (Rose & Marquis, 2011, p. 638). This is due to the fact that many institutional investors have applied the strategy of buying and keeping the bonds.

The United States of America have the largest market of corporate bonds and they represent a significant source of financing companies and dominant securities in the market of long-term bonds, which can be seen on the Figure 1.

Figure 1. Corporate Bond Total Issuance in the period from 2007-2014

Source: (IOSCO, 2014).

In Table 6 it can be seen that the amount outstanding of corporate bonds of US companies between the years 1980 and 2015 was significantly increased. Moreover, ever since the beginning of the great financial crisis in 2007 until the beginning of 2015, this type of corporate debt has been growing.

Table 6. Corporate bonds of US companies in the period from 1980-2015 (amount outstanding)

Year	1980	1990	2000	2010	2015
Value in bln $	366	1.008	2.230	3.376	4.807

Source: (Mishkin, 2007; www.federalreserve.gov).

Most commonly used corporate bonds in Great Britain are regular bonds. They are secured by the bond issuer's good credit standing. They are also called unsecured bonds or debentures (Mishkin & Eakins, 2003, p. 255). In Great Britain corporate bonds are often issued as guaranteed bonds. Their payment is secured by another economic subject (Jakšić, 2005, p. 231). Financially weaker bond issuers often buy financial guarantees in order to decrease their bond risk. Basically, the credit score of the subject that provides the guarantee is taken into consideration rather than the credit score of the bond issuer (Mishkin & Eakins, 2003, p. 257).

5. Development of corporate bonds in Serbia

Even though in developed financial markets corporate bonds are issued with long-term maturity of 20, 30, and even 100 years, in Serbia the maturity is significantly shorter. If we disregard the acts of issuing short-term debt securities of companies which had the same characteristics as short-term corporate bonds with short-term maturity of just a few days, the development of corporate bonds in Serbia began in the middle of 2010.

Company Telefonija a.d. Beograd in 2010 issued the first long-term corporate bonds in the Serbian capital market with maturity of four years, with worth of 50 million Serbian dinar. In July, 2010 "NLB banka a.d. Beograd" issued long-term coupon bonds with worth of 461 million Serbian dinar. These securities were issued in a closed way to already familiar buyers – professional investors, including insurance companies and pension funds. In August and October in 2010, company "Tigar a.d. Pirot" issued two series of long-term corporate bonds with worth of 250 million Serbian dinar and with maturity of five years. The bonds were issued to professional investors. In the middle of 2011, this company issued its third series of corporate bonds to familiar buyers with worth of 90 million Serbian dinar. Also in the middle of 2011, company "Galeb GTE a.d. Beograd" issued corporate bonds with maturity of five years. The bonds were issued in a closed way, and the investor that bought the entire issue was an Austrian insurance company that does business in Serbia "*Wiener Staedtische*". In 2012 two banks were actively involved as issuers of debt securities: *Societe Generale bank,* which issued the first long-term corporate debt security in Serbian dinar with no protective currency clause, and Erste bank a.d. Novi Sad, which realized the first primary public selling of debt securities in Serbian dinar in a regulated market.

The corporate bonds by *Societe Generale* bank were issued to previously defined qualified investors. These bonds entered the regulated market of the Belgrade Stock Exchange, in the *Open Market* segment, on September 14, 2012[2]. The investors came from the insurance sector and voluntary pension funds (equaling 8 or 15%) and the bank sector (equaling 3 or 85%).

The long-term dinar bonds of Erste bank a.d. Novi Sad had maturity in November, 2014. The secondary trade of long-term dinar corporate bonds of Erste bank started on November 30, 2012 in the *Open market* segment of the Belgrade Stock Exchange.

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[2] Read more at: http://www.belex.rs/k12/prezentacije/miladinovski.pdf.

Table 7. Issues of long-term corporate bonds in Serbia

Issuer	Issued in	Maturity	Interest rate
Telefonija Beograd	2010	4 years	7.5 + annual Euribor rate
NLB banka a.d. Beograd	2010	5 years	5
Tigar a.d. Pirot (1 and 2 issues)	2010	5 years	7.75
Tigar a.d. Pirot (3 issues)	2011	4 years	9
Galeb GTE	2011	5 years	7.85
Societe Generale banka	2012	3 years	5.25+ reference interest rate of NBS
Erste banka a.d. Novi Sad	2012	2 years	15

Source: own work.

It is important to notice that corporate bonds, unlike government bonds, can have a fixed interest rate and a variable interest rate, which can be seen in Table 8. Also, it is important to notice that, other than the bonds issued in 2012 (Societe Generale bank and Erste bank), all other long-term corporate bonds are characterized by a protective currency clause.

Bonds can be primarily issued by capitally strong and profitable companies. However, in Serbia such companies have no reason to collect funds by issuing bonds since all good companies can qualify to get a bank loan with subsidized interest rates. For instance, if they can get a subsidized interest rate of 4.5%, they have no reason to enter the free market and collect capital with an interest rate of 10%[3].

One of the countries which we can compare Serbia to is Croatia and for at least three reasons: firstly, the Zagreb Stock Exchange was re-founded two years later than the Belgrade Stock Exchange; secondly, it is a country which is a member of the European Union; and thirdly, it has a capital market which has a similar regulatory framework. The Law on the capital market which came into force in Serbia near the end of 2011 and replaced the until-then valid Law on the market of securities and other financial instruments is the highest law in the Croatian capital market since 2009.

The first corporate bonds in Croatia were issued in 2002, whereas their number increased in 2004. In 2006 only, in this area, six new corporate bonds were issued. At the moment there are 16 issued corporate bonds in the regulated market of the Zagreb Stock Exchange[4]. On the other hand, there are no corporate bonds in the Belgrade Stock Exchange at the present time.

6. Conclusion

For economy growth, it is extremely important to have a more developed financial market which implies a more efficient allocation of financial resources, that is an optimal relationship between the sectors of budget surplus and deficit. This is true especially in situations when the company's needs for financial resources are so great that they cannot be obtained from only one investor.

In developed markets, a significant role in financing companies is given to commercial papers and corporate bonds that are good competitors to bank loans. Commercial papers were discussed in the first part of the paper, where the basic characteristics of these securities and their usage have been analyzed. The fast growth of commercial papers started in the early 1980s and today they

[3] Read more at: www.jorgicbroker.co.rs.

[4] Read more at: http://zse.hr/default.aspx?id=26476.

are an important instrument of the US money market. Unfortunately, in Serbia commercial papers have not been developed yet because of inadequate legal framework.

In the second part of the paper, corporate bonds, their usage in developed markets and their development in Serbia were analyzed. However, as it is also the case with commercial papers, Serbia is also falling behind in this field compared to developed countries. There are numerous reasons and they can primarily be found in the relatively young and insufficiently developed capital market. One of the reasons of this low stadium of development of the market of corporate bonds is the low rating of certain companies which puts off potential investors which are ready to invest their financial resources. The first corporate bonds were issued in Serbia in 2010, but in a small number and to a known investor. Until 2012, there were no issued corporate bonds that had been realized without a currency clause and through a public offer in a regulated market. At the present time, there are no corporate bonds in the Belgrade Stock Exchange.

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Chapter 12

The Issue of Allocation of Financial Resources of Polish Households in Light of The Key Social Policies and Confidence in Financial Institutions[1]

Grażyna Plichta

1. Introduction

Economic conditionings, technological progress and socio-cultural transformations determine changes in the preferences structure of households. They result in adaptation processes, including, among others, the strategies of allocation of limited resources they have at their disposal. It should be stressed that the choice of a specific way of saving or investing involves risk. It also entails the assessment of the relationships between benefits and the financial and psychological costs of choosing individual product categories, therefore, trust plays an important role in this process. We can adopt a thesis that the lack of trust or too low level of trust directly influences the decision concerning the allocation of resources. The ways of saving and investing are also crucial with respect to national social programmes and policies conducted within this scope because they enable to determine areas which due to various limitations (barriers) do not develop in accordance with the established priorities. The essence of individual policies or programmes involves the verification of the adopted assumptions and the control of the achieved effects against the goals set. Discovering insufficient activities or the lack of activities within the implemented public programmes and policies is related to the proposal of their introduction. Although the applied evaluation provides reliable information about the value and significance of individual activities, the complex control tools used are a result of the low level of trust and generate bureaucratic actions and high costs.

The paper describes the role and the impact of trust on the shaping of attitudes related to managing money, saving and investing. It was assumed that the formation of socially desired behaviours of household members in the area of saving and investing depends on their actual state and the level of knowledge and economic education.

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2. Decisions of households in the area of saving and investing in the light of socially desired social policies and programmes – an outline of the problem

It is assumed that a social policy includes ventures which consist in taking interrelated decisions and actions by public authorities to achieve specific goals when market mechanisms are not applicable or they could not operate effectively enough on their own. The problem which occurs in the process of implementing an adequate social policy or policies is the scope of activities, as well as the scale of instruments and the type of intervention. Quite often, activeness in this area consists only in monitoring the situation, namely "doing nothing". In practice, concrete actions are needed and should be applied, and a great variety of different tools ought to be used for that. Depending on the situation, it should be a package of tools used in various proportions, starting from information and education via solutions based on market mechanisms. They could also include actions consisting in the use of strong intervention into the existing state of affairs, they could impose legal regulations, use direct interventions or interference with the freedom of the individual (within valid legal norms, of course). Examples of ventures undertaken within specific social policies, which, assumedly, are to bring a positive effect in specific areas, not only to individual households but also to the society as a whole, are activities consisting in, for example, eliminating a choice (e.g. prohibition of smoking in given places). Directing or suggesting a change in habits by means of adequate actions (e.g. a specific health policy concerning the elimination of fatty food from the diet, cutting down on stimulants) has a similar aim. In some situations or due to the adopted priorities, an adequate policy also aims at an increase in the scale of the choice an individual has (e.g. the access to private healthcare facilities under social security). It may also consist in actions which due to the adopted priorities suggest making a specific choice (e.g. in the situation of buying the access to the Internet to obtain a tax relief). Social policy may also comprise actions which, due to the adopted priorities, are to hamper and reduce the access to some goods (e.g. impediments in the access to alcohol).

The formation of socially desired behaviours of households in Poland in the area of consumption, saving and investing should be discussed with regard to the factual circumstances within the scope of the level of knowledge and economic education. Proper knowledge and successive economic education of society has measurable influence on the economic and social development of a country, as well as its current situation and the prospects for future development. Undoubtedly, it also influences the effectiveness and efficiency of social programmes and policies conducted in this area. The society having knowledge about economy and finance are at the same time consumers who, because of the possessed knowledge and quite often skills (as opposed to those who do not have them) make well thought-out market decisions. Having adequate means and in a rational way they are able to make use of the offer of products and financial services available on the market (Sagan 2014; Fatuła, 2010; Rószkiewicz, 2008; Wójcik, 2007).

The policy of the state, particularly in the area stimulating certain actions related to saving and investing, as well as the priorities connected with it aim at conducting and supporting such programmes and ventures which, with regard to the adopted criteria, are desired and in accordance with expectations. The evaluation of the conducted actions, in addition to the determination of the value of the obtained effects in line with the assumed aims, enables the identification of undesired phenomena. It is all the more important since in every situation, the fulfillment of the expectations

in line with the adopted aims is possible only in the case of the lack of limitations and barriers. The information obtained enables to specify limitations and phenomena constituting barriers which influence decisions concerning the allocation of limited resources of households. Thus, it gives a possibility to indicate the legitimacy of the introduction of an adequate policy within that scope.

The major barriers and limitations which directly influence the decisions of individuals and households in the area of saving and investing include:

1. The lack of the basic economic and financial knowledge.
2. The lack of the skill of using an offer from financial institutions (most probably arising from the lack of knowledge about the operations of banking systems and financial institutions).
3. Very strong barriers of inner, emotional and psychological nature, which negatively influence the perception of financial institutions and their offer.
4. Strong cult of cash (perceiving cash as the only real legal tender).
5. The lack of trust to banks and other financial institutions.

The existence if the aforementioned barriers and limitations is confirmed by the available research findings. They prove that the level of the economic and financial knowledge of Poles falls short of the expectations. It is the basis for the urgent introduction of actions aiming at the strive for the limitation, and in consequence the liquidation of problems related to it. The available research findings, including the quantitative research entitled *"Stan wiedzy finansowej Polaków"* (The State of the Financial Knowledge of Poles, 2009) in a detailed way presents the knowledge about economic issues, as well as Poles' habits connected with spending money. The findings formulated as a result of the conducted survey[2] enable to identify the areas in which economic knowledge is definitely low. The majority of Poles assess their economic knowledge as poor (as many as 62% of respondents), one-third as medium (33%), and an insignificant part as vast (5%). With definitely low self-assessment of own knowledge, the majority of respondents assumed that their knowledge is similar to the level of knowledge of other fellow citizens (61% assess it as similar). Out of those who assess their knowledge as different than the knowledge of the majority, almost 28% assess it as worse, whereas 11% as better. Moreover, the research enabled to familiarise with the habits of Polish people with regard to saving and investing, as well as their attitudes to money management. It also gave a possibility to determine the level of trust to financial institutions.

3. Trust and the problem of resource allocation on the financial market

In market decisions about investing and saving risk plays a significant role. Risk mitigation is a natural phenomenon. Uncertainty, namely the state when one cannot fully predict the consequences of undertaken actions, is related to risk. Uncertainty can be reduced by free access to information. When it is not possible, and the access to information is limited, the lack of transparency occurs, which hampers the accomplishment of the goals set. In the situation of commonly occurring risk and uncertainty, the factor which determines making a decision on the market is the presence of trust, which not only enables to overcome possible doubts, obstacles and

[2] The survey was conducted on a representative quota sample of 1,505 adult Poles at the turn of July and September 2009. The research tool: direct structured interviews – CAPI *(Computer Assisted Personal Interview)*; The executor of the field part of the survey: Pentor Research International.

inconveniences but is a significant element in the process of building permanent relationships (Sztompka, 2007; Hardin, 2009).

Trust plays a special role when decisions concern saving or investing. It is important because there is distrust not only to the subjects but also the object of the transaction. It is significant when decisions are taken to which the parties to the transaction have different expectations, most often there is no parametricity between the subjects and the relations between them are complicated.

Due to great asymmetricity on the market between firms/institutions and potential consumers/households consumer trust is vital. It should be remembered that a firm (e.g. offering financial services or products) most often has a considerable financial/information and technical advantage. Trust building in such a situation is based on the conviction that the stronger party (the firm) will not use its advantage against the weaker party (the customer).

We can assume that the following can favour building the consumer trust:

- general attitude of trustfulness or distrustfulness of the consumer,
- the consumer's earlier experiences,
- professionalism of the party to the transaction,
- emotional relationship of the consumer with the representative of the party to the transaction,
- the level of legal and institutional protection of the consumer,
- the perspective of the repeatability of the transaction (Hirsch, 2012, p. 23).

Trust between the parties to the transaction is crucial in the case of firms whose activities are related to offering financial products. Only then will the customer take advantage of, for example, "pension schemes" or "investment advice", or another diversified offer if he/she trusts the financial institution and has no doubts that its objective is help, advice and support, and not only a particular business and profit. It is important to gain potential trust which depends on the reliability of the firm, the fulfillment of individual needs and safety.

Established, repeatable trust arises mainly from satisfaction which may be a result of obtaining the expected quality of a product/service. Interactional, procedural and retributive justice participates in the trust formation process. In accordance with it wrongs should be remedied.

Therefore, the way in which financial institutions, for example, react in conflict situations, namely filing complaints and motions by customers, is not without significance. Also customer satisfaction being an effect of a well-handled complaint when there are objections to a purchased product or service, is of great significance. We can say that contacts on the market are maintained with those who are trusted. However, it does not mean that without trust a transaction in impossible since when looking for a bargain subjects often behave irrationally. Established trust arises mainly from satisfaction. To maintain it, it is necessary, among other things, to:

- successively educate customers (especially in services trust performs the function of the perceived quality and the education of customers. It is assumed that the growth of customer education entails the growth of trust),
- make necessary, constant changes in infrastructure, for example, changes related to innovations, investments, a change in the image (e.g., during recession institutions change their decor, resign from luxurious accessories),
- personalise a message, a service (particularly important in the transactions fully effected by means of modern technologies),
- implement and use quality certificates,
- successively broaden the offer, improve its attributes and availability,
- articulate trust directly to customers.

In Poland, financial institutions, including banks, are not really trusted. It is confirmed by available research findings. Distrust to financial institutions is confirmed by the findings of the research conducted by various institutions, among others the National Bank of Poland *"Postawy Polaków wobec obrotu bezgotówkowego"* (Polish attitudes to cashless transactions, 2010), *"Postawy Polaków wobec pieniędzy oraz instytucji i instrumentów finansowych. MoneyTrack 2010"*, (Polish attitudes towards money institutions and financial instruments, 2010), Centre for Public Opinion Research, surveys 2009 (CBOS, 2009). Financial institutions are always ranked on lower positions (e.g., in comparison with FMCG, media, motorisation, trading companies) in the cyclic reputation research by Premium Brand firms (Cyclic reputation survey companies Premium Brand, 2010). It seems that the displayed distrust to the whole financial system arises not only from the lack of sufficient knowledge about the mechanisms of the operation of this industry, but also from the influence of historical factors. Distrust in this case is the effect of excessive caution of Polish people, particularly the older generation which remembers the denomination in the times of the Polish People's Republic, hyperinflation of the 1990s, that is the period in which lots of people lost the savings of the whole life. Participants and the witnesses of those events are often not interested in any financial services, even in having a bank account (Maison, 2013, p. 82). Such a state of affairs undoubtedly influences the fact that in spite of a broad offer of the financial market, Poles often "deposit" money in proverbial socks, linen cupboards or drawers. The situation does not change in spite of free access to banks and diverse financial products commonly offered on the market. The research carried out regularly by the financial sector firms show that Poles prefer cash. Nearly half of Polish people (mainly retired people) receive their pension in this form (e.g. from the postman). Beside old-age pensioners, also a large part of the working population uses only cash. According to the GFK Polonia research, over 30% of the working population aged 35-50 does this, namely keeps all savings in so-called "sock". The quantitative research into the financial education of Poles shows that in our country there is strong attachment to paper money, as 54% of Polish people express the conviction that only "cash is the real money" (The findings of the research carried out in 2009 and ordered by the Kronenberg Foundation. The working title of the report *"Edukacja finansowa Polaków. Raport z badania ilościowego"* (Financial Education of Poles. A Report from the Quantitative Research, 2009). Such opinions depend on the age, education and income of respondents. A vast majority of elderly people regard the physical money the only "real legal tender". As many as 67% of people above 55 years old declare so although also a great percentage of younger people, under 34 years of age (46%), agree with this opinion. The emotional attachment to cash is indicated by 34% of people with higher education and twice as many people with primary education (as many as 64% of respondents). Cash is "most valuable" for people with the lowest income, below PLN 1,000 per person (61%). With increasing income, sentiment to cash decreases. Also people functioning in so-called informal sector prefer cash (Maison, 2013, pp. 87-88). The size of this phenomenon and the scale of cash involved is impossible to be precisely determined. What arises from the estimates of the Central Statistical Office is that around one million people may be working illegally (hired mainly in the country, in construction and services). In the situation when workers are employed illegally, the parties are interested only in paying remuneration cash-in-hand. This type of practice (or rather ill practice) makes employers "save" on insurance contributions and taxes. The illegal sector workers most often spend money on an ongoing basis, if they save, it is only in cash, outside official institutions of the financial sector, also to prevent detecting/checking the scale of their illegal income. The preference of cash is also observed among people who have a bank account. They do not often use the card, they do

not pay with it on an ongoing basis, at most they use it for one-time paying out the available funds (e.g. the whole pay) (Maison, 2013, pp. 87-88).

According to the research of the National Bank of Poland, in 2010 4 out of 5 Poles had a bank account, although with regard to their number, the situation in our country is changing, evolving towards the direction similar to the one which can be observed in the majority of developed countries. A few years ago only every second Pole had a bank account. However, it should be stressed that as many as 20% of the owners of those accounts never took advantage of the privilege connected with possessing them, namely withdrawing available funds from the cash machine on an ongoing basis. If this possibility was used, it was done occasionally. As for the number of bank accounts in Poland per capita, we are on a similar level as the Czech Republic or Hungary – Poland: 0.93 per capita; the European average: 1.26 per capita[3]. Only in Italy and Spain the situation is worse. The research carried out by the National Bank of Poland *"Postawy Polaków wobec obrotu bezgotówkowego"* (Attitudes of Poles towards Non-Cash Turnover, 2010) shows that 78% of adult Poles have an account. The research findings prove that the very fact of having a bank account more often prompts the account owners to use services and products of financial institutions. However, it should be emphasised that the decision to take advantage of a financial institution's offer should always take into consideration the real skill of managing one's own money. It is really important because the offer of financial institutions, including the products which aim at saving or investing, are always related to risk. The risk concerns the safety of the entrusted funds in the subjective aspect (to whom the funds are entrusted) and the objective aspect (products which serve saving, products one can or should invest in, etc.). Risk is connected with loss, therefore, when taking a decision which is related to the employment of own funds in hope to achieve benefits within a specific period in the future, in all circumstances it is necessary to answer the question concerning a possible level of the accepted loss. The inclination to take risks is individual and influences the decisions taken. The decision connected with investing money is the choice between safe saving and the use of possibly safe financial products for this, or investment in more risky products. Investment in products objectively perceived as less safe can in fact bring considerable profits but in unfavourable circumstances it means the loss of some invested funds. The research shows that even if the decision to take advantage of a specific offer is taken, the simplest bank deposits are chosen, in spite of a great variety of products.

From the point of view of a specific social policy, the very attitude of Poles to saving is an important issue. From the economic point of view, there is a significant relationship between the level of income and the inclination to save, namely, the higher the income, the bigger capabilities of making savings. It seems, however, that the level of savings does not depend on the level of income alone, but it is also influenced by other factors, including the age. Available data indicate the distribution of the inclination to save among age groups: increasing in the age ranges of 25-34 years old, 34-44 years old, 55-60 years old, and decreasing in the ranges of 44-54 years old and over 60 years old (Czapiński & Panek, 2009). The findings of the research into the situation on the consumer finance market, conducted in the 3rd quarter 2013 (The Situation on the Consumer Finance Market, 2013) proved that as many as 77% of households think that in the current economic situation the climate to save is unfavourable. It probably arises from the low level of interest on deposits (among the vast majority of the society saving is understood as deposing money in banks).

[3] Analyses of the Payment System Department of the National Bank of Poland based on the data for 2009, published in the Statistical Data Warehouse of the European Central (Blue Book, 2010).

The forecast related to the persistence of such a situation in a longer term has impact on the assessment of saving in the future. The most frequent goal of saving is declared consumer spending and the renovation of the house or the flat. In the 3rd quarter 2013 around 13-15% of households saved with the intention of buying small durable goods or for recreation. Moreover, in the years 2008-2013, a 10% increase of saving without any special purpose was observed[4].

One of crucial goals is saving with future retirement in mind, although accumulating funds in various form and treating them as the provision for old age is not common in Poland. The findings of the research carried out in May 2013 by the Chamber of Fund and Asset Management in cooperation with the Centre for Public Opinion Research "How do Poles Save for Retirement" indicate that only 13% of Polish people put aside additional funds for retirement, whereas 55% do not save and have no plan to save. As the reason for not saving for this purpose the majority of respondents mention the lack of sufficient funds. In spite of the awareness that a potential pension with regard to its amount will be insufficient, in the opinion of as many as 59% of respondents, the amount of the possessed funds makes it impossible to save, and the means which are at their disposal are in whole intended for current consumption. In spite of consuming almost the entirety of the possessed means on an ongoing basis, at the same time almost half of respondents declare an ability to put aside a certain amount of money regularly (most frequently oscillating around 200 zlotys). According to Dominika Maison, PhD, from Maison Research House, the discrepancy between the fact of not saving because "we can't afford to save for retirement", and the simultaneous declaration of putting aside a certain amount of money every month does not have to mean the real lack of financial abilities. Most often, it results from the lack of adequate motivation and the conviction "why to save, it's better to spend". The lack of motivation to save may be caused by increasing consumption. Immediate consumption of goods is supported by a common phenomenon called by psychologists an inability to delay gratification. It seems that this state of affairs results from the mentality of many Poles and the consequent conviction about the responsibility of the state, and not them themselves for the financial situation of retired people and their livelihood. On the other hand, the base for such behaviour is the psychological aspect and a specific attitude related to it. It indicates that people more inclined to save for their retirement are those with a specific vision of spending it, and thus use the accumulated funds. Unfortunately, a large part of Polish people have no interests and spend their free time passively, therefore, they are not inclined to save to spend the retirement time actively.

The findings of the research carried out by the Chamber of Fund and Asset Management point out that among people who actually save additionally for their retirement, the most popular are: personal accounts (31%), insurance policies (28%) and investment funds (23%). Possessing Individual Retirement Accounts is declared by 15% of respondents, a half of which are Individual Retirement Accounts with investment funds. In the light of the conducted research, every fourth zloty intended for additional retirement goes to the funds. A large percentage of the surveyed Poles, that is 41%, think that investment funds are a good tool to accumulate retirement savings. However, as the research proved, as many as about 30% of respondents have insufficient level of knowledge on financial products and, consequently, an inability to assess them. It is the more disturbing that

[4] The research is conducted by the Research Institute for Economic Development at Warsaw School of Economics (IRG SGH) and the Conference of Financial Companies in Poland quarterly since 2006. The survey is conducted on a representative group of households with business condition survey method. An independent part of the research programme – Research on the Condition of Households in Poland, conducted in IRG SGH since 1990.

the lack of knowledge and skills within this scope makes it impossible to take rational decisions about long-term saving. It concerns both the inability to assess the amount of one's own pension and to indicate the best ways of saving and to compare various forms of saving. Moreover, a vast majority of respondents do not know the principles of the functioning of Individual Retirement Accounts (the product created in Poland for additional accumulation of retirement savings in the 3rd pillar) well enough.

According to the report from the research conducted in 2013 by OECD with regard to the level of savings of households, Poles lag behind not only the majority of the developed countries of the Eurozone, but also the Czech Republic, Hungary and Slovakia. Available research findings prove that only every third Pole accumulates savings (Between issuing a deposition, that is, saving and investing in Polish, 2013). The savings possessed are most often an equivalent of one monthly salary, whereas very few Poles, only 6%, have over a half of bank deposits.

4. Conclusion

Economic awareness of the society and trust to financial institutions are attributes of an economy built for years. The lack of basic economic knowledge on the one hand has impact on the sense of threat and uncertainty, and on the other hand makes the understanding of phenomena occurring on financial markets and taking rational decisions impossible. Due to definitely unsatisfactory state of knowledge and the economic awareness of Poles, there is a necessity to conduct comprehensive educational activities. Without a proper policy on economic education and economically and financially aware society, it is not possible, among others, to take decisions concerning saving or investing, or the stable economic growth.

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Chapter 13

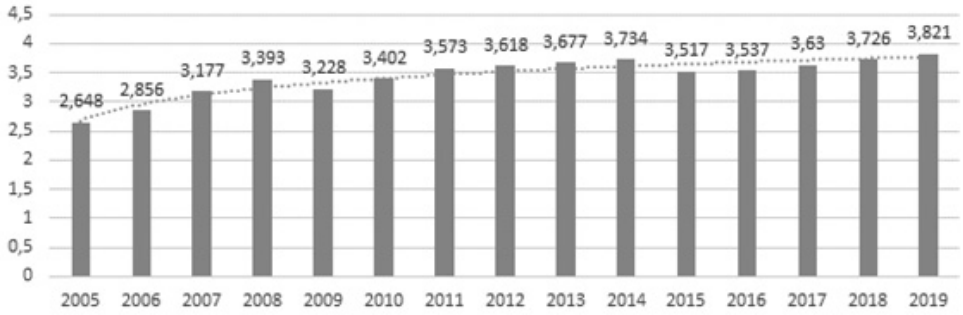
Information Technology Investment Valuation under Uncertainty. Review of Literature

Paweł Lustofin

1. Introduction

Relatively recent study conducted by McKinsey and CO showed that large IT projects (with budgets in excess of 15 mln $) tend to run 45% over the budget and 7% over time, while delivering 56% less value than expected (Bloch, Blumberg & Laartz, 2012). This study indicates very strongly high risk profile of large IT investments. Simultaneously according to CIO survey data IT expenditure accounted for roughly 5.2% of companies revenues on average in 2013 (data include both operational and capital expenditures). This on the other hand indicates that companies are becoming increasingly exposed to the risk stemming from IT/IS projects. Below we would like to present Figure 1 illustrating IT expenditure growth trends.

Figure 1. Global IT Spending (actual figures for 2005-2015 plus forecasts until 2019), in bln USD



Source: (*Global IT*…, 2016).

According to figures presented above an absolute spending on IT will have grown by 44% between 2005 and 2019 – a considerable increase. At the same time as stated above IT projects

(which costs are by definition included in the above presented data) are characterized by relatively high risk profile. Those risks can be divided into exogenous ones (from firm's perspective) stemming from the unpredictability of market environment as well as endogenous risks such as: monetary risk (the risk that a company will run out of funds to finance project); project risk; functionality risk and organizational risk (Hilhorst et al., 2008). At the same time Irani (2010) draws attention to big challenge that manager's often face in regards to valuation of intangible benefits of IS implementations and indirect organizational costs that those entail. Total Cost of Ownership, a comprehensive tool and philosophy dealing with strategic management of costs in organization, may be a very useful technique in cost estimation. TCO enables an effective approach to cost accounting that forces managers to move beyond the evaluation of obvious direct costs by taking into account indirect impact on cost base that is determined by the given purchase (Ellram & Siferd, 1998). According to Gartner TCO includes hardware and software acquisition, management and support, communications, end-user expenses and the opportunity cost of downtime, training and other productivity losses.

According to the study of 130 CIOs conducted by the Kellogg School of Management in collaboration with the Society for Information Management around 80% of respondents find it difficult to evaluate IT projects and do not have any formal process to prioritize their IT investments. Interestingly according to survey conducted by Graham and Harvey (2001) on 4000 CFOs around 27% of respondents always or almost always resort to real options in project evaluation (compared with 75% of respondents using NPV). On the other hand a survey of 452 senior executives (conducted by Bain & Company in 2001), who tried the real-options approach to project valuations, showed that a third of them stopped using it that same year. The reason for giving up on this method were technical difficulties. At the same time according to Benaroch and Kauffman traditional discounted cashflow based valuations will always undervalue investments (1999). The main weakness of discounted cashflow based valuations in regards to IS/IT investments are high interest rates (charged to account for risk as well as time value of money). Charging high interest rates will inevitably penalize especially those cashflows which are expected to be received long in the future (this on the other hand can turn out to be a significant downside if we consider long learning curve for some of IT systems). It is equally important to stress that traditional methods completely ignore the fact that various real options may be embedded in the IT/IS project in order to allow managerial intervention in case a particular risk materializes (Benaroch, 2006). If specific real options are embedded and provided that organization facilitates and encourages their exercise than traditional Net Present Value is the representation of the lowest expected value of an IT project (Taudes et al., 2000). Apart from the computational difficulty of discounted cashflow methods (especially for managers outside of finance and controlling departments) the above mentioned weaknesses further discourage and disincentivize managers from applying financial methods to evaluate proposed projects. In the following section we will focus on the real option valuation methods. Analysis of real options embedded in the IT/IS projects will follow. Within the scope of our literature review are two variables: 1) options pricing models applied as well as stochastic processes and 2) real options studied. We extend the aforementioned scope by including analysis of the important empirical studies on real options exercise in real life settings. Those studies are critical as they provide empirical support that validates the underlying assumption that examined publications resort to and namely that real options in fact do poses value.

2. Real options valuation methods. Application of quantitative finance to capital budgeting

We begin our analysis by identifying selection of option pricing formulas applied by authors to Information Technology projects. We extend the list of option pricing formulas and include real options techniques developed specifically for purposes of real options valuations (please see details in Tab. 1).

Table 1. Real options pricing models

Valuation model (Real Options)	Definition	Application in Quantitative Finance	Researched in
Margrabe model	Prices option to exchange one risky asset for another	Used to estimate value of spread option, compound exchange option, traffic-light option	• B. L. Dos Santos (1994) • B. L. Dos Santos (1991) • R. L. Kumar (1999) • J. Cypryjański, T. Łukaszewski (2002) • I. Bardhan, et al. (2004)
Black Scholes Merton model	A model of price variation over time of financial instruments such as stocks that can, among other things, be used to determine the price of a European call option. The model assumes that the price of heavily traded assets follow a geometric Brownian motion with constant drift and volatility	Used to estimate value of European call option	• M. Benaroch, R. J. Kauffman (1999) • F. C. Harmantiz, V. P. Tanguturi (2007) • A. Taudes M. Feurstein, A. Mild (2000)
Binomial model	The binomial option pricing model uses an iterative procedure, allowing for the specification of nodes, or points in time, during the time span between the valuation date and the option's expiration date)	Useful for valuation of American options	• M. Benaroch, R. J. Kauffman (1999) – discussed not applied
Log-transformed binomial model	The log-transformed variation of binomial option pricing has been designed to overcome problems of consistency, stability, and efficiency encountered in the Cox, Ross, and Rubinstein (1979) and other numerical methods	This method handles well options with a series of exercise prices (compound options), non-proportional dividends, and interactions among a variety of real options	• M. Benaroch (2002)
Schwartz and Moon (2000) model	It is a model, that has been developed for evaluating R&D investments based on three stochastic processes related to costs; benefits and possibility of catastrophic event. It is based on Pindyck's results (1993)	Originally developed to value R&D investments	• E.S. Schwartz, C. Zozaya-Gorostiza (2000) • M. Benaroch (2002)

Source: own research based on the literature review within the scope of this paper.

We follow with the list articles relying on the stochastic processes in the process of real options valuations (Tab. 2).

Table 2. Stochastic processes

Stochastic proces	Definition	Researched in
Mean reverting process	A theory suggesting that prices and returns eventually move back towards the mean or average. This mean or average can be the historical average of the price or return or another relevant average such as the growth in the economy or the average return of an industry	• E. S. Schwartz, C. Zozaya-Gorostiza (2000) • R. J. Kauffman, J. Liu, D. Ma (2015)
Brownian motion (Wiener process)	Brownian motion is a simple continuous stochastic process that is widely used in physics and finance for modeling random behavior that evolves over time	• L. H. R. Alvarez, R. Stenbecka (2004) (partial outsourcing in production setting, non IT project) • M. Taudes, A. Feurstein, A. Mild (2000)
Stochastic mixed-integer programming (MIP) model	A mixed-integer programming (MIP) problem is one where some of the decision variables are constrained to be integer values (i.e. whole numbers such as –1, 0, 1, 2, etc.) at the optimal solution. The use of integer variables greatly expands the scope of useful optimization problems that you can define and solve	• F. Wu, H. Z. Li, L. K. Chu, D. Sculli, K. Gao (2008)

Source: own research based on the literature review within the scope of this paper.

In addition to the above listed models Zhu and Weyant (2003) built a multi-period game theoretic model which takes into account asymmetric information and competition. According to literature competition might have an impact on valuation and exercise of an option. The multi-period game theoretic model developed by the authors embeds the dynamics of particular markets. Payoff function is structured according to three models: 1) Nash-Cournot equilibrium; 2) Stackelberg leader-follower equilibrium and 3) monopoly. Model shows that competition leads to the erosion of option's value. Paradoxically according to their model having better information might actually harm a firm. Moreover sequential ordering of options reveals private information. Game Theory techniques are also applied by Angelou and Economides (2014).

Mathematical concepts applied in the analyzed literature are characterized by relatively high complexity which demands advanced numerical skills. It can be safely assumed that analyzed literature will not facilitate proliferation of applied real options concepts into corporate settings. In five publications Margrabe model has been applied and in 3 articles authors resorted to popular Black Scholes Merton model. In none of the analyzed articles have the authors resorted to the Binomial model one that is intuitive in nature and does not require advanced mathematical skills. Authors must be aware that there will be a strong trade-off between precision (and hence complexity) of the model and expected adoption of quantitative methods for project evaluation in the corporate setting. Copeland and Tufano (2004) stress that Black-Scholes-Merton model is not the most appropriate model for valuation of real options. Authors recommend using the binomial

method which, they argue, addresses the contingencies of real options and captures the iterative nature of managerial decisions.

3. Real options studied

Real options define the flexibility which the option pricing methods (described in Tab. 1 and 2) try to express in financial terms. Below (Tab. 3) we present an overview of real options applied (or discussed) in the context of Information Technology and Information Systems investment project.

Table 3. Overview of real options. Overview of literature

Real Option	Definition of real option	Type	Applied in
Growth Option	This option exists when an initial baseline project open the door to pursue a variety of potential follow-on opportunities	Strategic	• B. L. Dos Santos (1991) (applied) • M. Taudes, M. Feurstein, A. Mild (2000) (applied)
Option to defer	This option exists when a project can be postponed in order to learn about the potential investment outcomes before committing to the entire project	Operating	• B. L. Dos Santos (1991) (applied) • B. L. Dos Santos (1994) (applied) • M. Benaroch, R. J. Kauffman (1999) (applied) • E. S. Schwartz, C. Zozaya-Gorostiza (2000) (applied) • K. Zhu, J. Weyant (2003) (applied) • F. C. Harmantiz, V. P. Tanguturi (2007) • G. N. Angelou, A. E. Economides (2014) (applied)
Option to expand/decrease scope	Option to change scale exists when allocated project resources can be contracted or expanded in response to future conditions, or when the delivered application can be scaled up or scaled down with comparative case		• F. C. Harmantiz, V. P. Tanguturi (2007) (applied)
Option to explore (conduct preliminary study, pilot or develop prototype)	Exists when management creates flexibility to partially invest in prototype effort. Building parts of an application using prototyping can be used to conduct performance tests, technical feasibility studies or study technology issues		• L. Dos Santos (1994) (applied)
Portfolio of options describing decision scenario	Value of options is created by quick access to information		• R. L. Kumar (1999) (applied)

Compound options	Multiple (cascading) options	Operating	• F. Wu, H. Z. Li, L. K. Chu, D. Sculli, K. Gao (2008) (applied) • M. Benaroch (2002) (applied) • I. Bardhan, S. Bagghi, R. Sougdtad (2004) (applied)
Stage-growth/ stage-abandon options	This exists when project can be divided into distinct stages when pursuit of each stage is contingent on a reassessment of costs and benefits at the time proceeding stage is completed. Option to abandon exists when a project can be terminated midstream and and remaining project resources relatively easy redeployed		• R. Fichman, M. Keil, A. Tiwana (2004) (only discussed) • J. Cypryjański, T. Łukaszewski (2002) – applied
Option to switch use	Exists when a particular IT asset can be used for another business purposes		• R. Fichman, M. Keil, A. Tiwana (2004) (only discussed)
(Partial) outsourcing	Contracting part of operations in a given are to outside service provider, thus switching fixed costs to semi-varibale one		• L. H. R. Alvarez, R. Stenbecka (2004) (article based in production setting)

Source: own research based on the literature review within the scope of this paper.

The most frequently studied real option is option to defer (modelled in 7 publications). It is a proactive form of managerial intervention in which managers focus on gathering information helpful in assessing level of uncertainty at the given time. As far as other operating options are considered the next best studied (in case of IT projects) are compound options (3 publications) followed by strategic (growth) options. It is however worth to point out that the conceptual logic underlying both of the two aforementioned options (growth and compound options) is very similar. Option to explore has been applied only in case of one publication even though in case of many projects (especially large IT projects) its value might be substantial. Option to switch use has only been discussed, but no financial model has been applied. Interestingly there are no publications which would make an effort to apply provisions of real options in the context of IT outsourcing or cloud computing, even though both are characterized by embedded flexibility to change the scope of service (the degree of which is dependent on the legal terms). In the next section our analysis is extended to some interesting empirical studies conducted to better understand real option theory in the real life setting.

4. Beyond Sheer Valuation – Real Options as Risk Management Tool

Fichman et al. (2004) extend existing academic research in the realm of real options by analyzing real options from the project management angle. Their study is supported and illustrated with the description of various real cases. Authors suggest that incorporating real options into project

management might potentially yield more benefits than resorting to real options as simple valuation tool. Nonetheless authors stress the importance of organizational culture that facilitates "option exercise". Organizational culture and formal procedures are key determinant for implementation of real options based project management just as numerical skills are necessary for the implementation of real options based valuations (in addition to traditional budgeting techniques). Furthermore according to another study by Tiwana, Keil and Fichman (2006) on the impact of perceived value of real options in information systems projects on the manager's willingness to commit to project continuation (in cases where NPV = 0) managers are in fact aware of the real options that a given project embeds. The study conducted on 123 firms authors unveils a strong evidence that presence of real options in the project does in fact lead to tendency to continue "troubled" IT investments. The higher the number of real options the bigger the tendency to continue project. Also, managers place much higher value on growth options (strategic options), rather than operating ones. Hilhorst et al. (2008) performed an exploratory experiment to study connection between the perceived value of real options and risk factors. The research provides an empirical indication, that the intuition of IT managers is partly consistent with the risk management logic. Results show, that IT managers have an overall preference towards option to stage and option to prototype (proactive stance towards risk). Nonetheless managers may be inclined to undervalue an option to abandon. Furthermore Tiwana et al. (2007) provided a strong evidence that managers face systemic biases in their perception of real options present in IT projects. The study indicates that when easily quantifiable benefits in IT project are high managers will most likely fail to notice and take advantage of the value of shadow real options present in the given project.

5. Conclusion

There is relatively small amount of publications dealing with quantitative application of options pricing methods in the valuation of IT/IS projects. Moreover methods applied by the authors are rather difficult, demanding advanced mathematical skills. Application of more intuitive methods such as binomial model is rare. Also in our opinion it is worth to consider real options approach to such areas as outsourcing of Information Technology or cloud computing. In addition to that we strongly believe that it is worthwhile to present application of binominal model in case of different prototyping options that IT implementations most certainly poses.

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PART III

CHALLENGES AND DEVELOPMENT OF MODERN ACCOUNTING

Chapter 14

Creative Accounting – Review of Definitions from Different Countries and Regions of the World[1]

Artur Hołda, Anna Staszel

1. Introduction

The aim of this paper is to show how the concept of creative accounting is defined and how it operates in the literature of different countries and regions of the world. Research method involved a critical analysis of professional accounting literature from around the world and was used in order to examine how creative accounting is defined in different countries of the world. The search results for the phrase "creative accounting" in 17 languages were collated and analysed, and the information was subsequently summed up and characteristic trends were isolated.

It should be noted though that although numerous authors presented different definitions of creative accounting in their publications, they, unlike the authors of this paper, did not carry out studies which would comprehensively collate definitions of creative accounting from different countries.

This paper is the first attempt at comparing definition of creative accounting given by authors from different parts of the world, thus enabling determination of the global trend in the field of defining and perception of creative accounting.

The results show that, depending on the region, creative accounting can be perceived as a positive phenomenon (e.g. in Central and Eastern Europe), a neutral one (e.g. in South America), or it may be directly associated with financial statement fraud (mostly in German and English-speaking countries).

Understanding of the concept of the creative accounting leads to understanding of the essence of accounting. It is not a trivial matter since it is the information provided by accounting and presented in financial reports that is the foundation of many economic decisions.

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2. Early definitions of creative accounting in English language literature

The term "creative accounting" was present in English language texts already in the 1970s and indicated a deliberate policy pursued by managers to deceive shareholders, creditors and themselves (or all there) regarding a company's wealth and progress in general and its financial difficulties in particular (Argenti, 1976) yet the term became famous in the wake of the journalist, Ian Griffith's well-known 1986 statement: "Every set of published accounts is based on books which have been gently cooked or completely roasted. … It is the biggest con trick since the Trojan horse... In fact this deception is all in perfectly good taste. It is totally legitimate. It is creative accounting" unambiguously defining creative accounting as a clever manipulation of financial data. Other authors – Jones (2011), Breton and Taffler (1995), Smith (1992) offered similar definitions. Thus for British authors, creative accounting means manipulation of financial data, clever deception that helps influence the decisions made by users of financial statements within the bounds of law, but in a morally questionable manner. Similar opinions are held by US authors Edwards (1989), Nasser (1993) or Comiskey and Mulford (2002). Australian or New Zealand authors also define creative accounting practices as activities aiming to mislead stakeholders (Bosch, 1990; Revsine, 1991).

Despite the fact that the principle of true and fair view plays an important role in the accounting systems of the countries of Anglo-Saxon accounting, creative accounting is conceived there as a clearly negative phenomenon consisting in manipulation of financial data in accordance with the will of the board to obtain specific benefits by deliberately misleading users of financial reporting (Hołda & Staszel, 2014). Strangely enough, although English-speaking authors were the first time to define creative accounting, authors from other countries do not always agree with their definition and unambiguous classification of creative accounting as a negative practice. At the same time, there exist numerous authors from other countries that highlight positive aspects of creative accounting.

3. Definitions of creative accounting in Spanish-, Portuguese- and French-speaking countries

The issue of the accurately defining creative accounting is addressed by many French authors. The term "creative accounting" surfaced in France as early as 1992 (Gélard, Barthes & de Ruyter, pp. 31-35) and a large number of other authors emphasised the negative aspect of creative accounting, treating it as manipulation (Stolovy & Breton, 2000, p. 44; Felaga & Malciu, 2002; Dima, 2012). However, an equally large group of French authors contradicts this unambiguous definition of creative accounting (Raybaud & Teller, 1997; Briciu, 2006) indicating that, firstly, creative accounting is a technique which admittedly shows the best possible picture of the entity (which may be misleading), but is also of benefit for investors as it paints a better picture of their companies externally (Trotman, 1993), and secondly, can be used not only for bad ends (data manipulation), but also good ones (to give a true and fair view of economic reality in the books).

Creative accounting is of interest to many authors from Spain, where this subject was taken up very early, right after the term became popular in the UK. In 1992 Giner (p. 4) wrote that there are areas of accounting that even demand the application of individual judgment and estimation, i.e. creative accounting. Also Gabas (1991, pp. 115-116) pointed out that normative accounting

as such does not exist, and creative accounting means simply the right to choose between different solutions for which there are no clearly defined mathematical rules. Thus, Spanish scientists in contrast to English-speaking authors (Amat & Blake, 1995) do not attribute a uniquely negative meaning to creative accounting. However, not all Spanish authors agree with the positive aspects of creative accounting, indeed some indicate that creative accounting means only negative practices (Lainez & Callao, 1999).

Authors from South American countries often refer to definitions of American and British authors and state that accounting is about distortion of information with the intent of inducing users of financial statement to make decision desired by the board (dos Santos & Grateron, 2003). At the same time, South-American authors underline the fact that the concept of creative accounting encompasses much more than the mere notion of manipulation: creative accounting is misleading, it can change an entity's results and even alter the results of financial ratios.

Yet, Brazilian and Venezuelan authors, apart from emphasising the harmful aspect of creative accounting, also indicate that without flexibility, accounting would not be able to fulfil its basic function, i.e. it would not generate information reflecting the reality, and for that reason should be regarded as a "necessary evil" (Nascimento et al., 2015; Cosenza & Grateron, 2004). On the other hand, Chilean researchers try to show that creative accounting can be a very useful tool when used in good faith, but one which has dire consequences when it is improperly used in order to commit fraud (Viloutta & Farras, 2005).

4. Positive aspects of creative accounting perceived by accounting theoreticians from the Balkans

Serbian authors define creative accounting as altering information from what it is to such as the compilers of the information would gladly see (Dukic, 2014; Pavlović, 2014), treating creative accounting as an utterly negative phenomenon, synonymous with fraud (Kaparavlović, 2011). Similar views are expressed by Slovenian authors who define creative accounting unambiguously as intentional deception, or who use the well-known comparison of creative accounting to the Trojan horse and dub it the ultimate scam (Malinić & Stefanović, 2009). Belak (2011) goes one step further and claims that creative accounting mainly involves activities going beyond the bounds of law, constituting a bona fide crime.

Meanwhile, Croatian authors note that there is no unequivocal definition of creative accounting and go on to add that not all definitions equate it with manipulation or fraud (Dimitrić, 2012). Vremec (1995) indicates that creative accounting also has a positive aspect as it involves a reasonable application of original, untried ideas to recognise non-typical, new situations which still gives a fair view of the company. These same views are shared by the majority of Bosnian authors (Friganović, 2015) who indicate that the purpose of creative accounting is to give a true and fair view of the entity, at least in theory, but in practice, unfortunately, creative accounting comes down to manipulative accounting.

In Bosnia and Croatia therefore an opinion prevails whereby creative accounting allows one to give a true and fair view of the entity's financial position and actual performance. Romanian authors (Grosanu, 2013), however, point two definitions of creative accounting, the first of which focuses on manipulation, and the other underlines imagination and innovation used in areas which are not regulated by detailed accounting regulations (Hołda & Staszel, 2016). According to accounting

experts from Romania, the first approach combining creative accounting and manipulation is wrong because creative accounting must not be associated merely with negative behaviour. Yet, there are also Romanian authors (Ionescu, 2006) who by citing mostly English authors' definitions define creative accounting as manipulation.

5. Creative accounting defined by authors from Poland and countries of Eastern Europe

Some Polish authors, e.g. Wąsowski (2005) associate creative accounting with fraud, but most do not perceive creative accounting as a merely negative phenomenon. According to a large group of Polish authors, creative accounting should be identified with innovation in the manner of calculating values to be disclosed in financial statements (Surdykowska, 2004) rather than with manipulation. According to Polish authors, creativity is an inherent feature of accounting and leads to the accurate achievement of the purposes of financial reporting, as it involves a sophisticated and creative application of accounting principles and methods (Hołda & Staszel, 2015a).

A large group of Polish authors views creative accounting as an ambivalent phenomenon (Hołda et al., 2006), a domain of accounting freedom. Gut (2006, pp. 11-12) indicates that creative accounting consists in such presentation of economic events that are both consistent with the law and, importantly, in accordance with appropriately interpreted accounting principles and which are not explicitly mandated by regulations. Polish authors emphasise, however, that – like with any kind of freedom – it can be used either in accordance with the law as an expression of the desire to give a true and fair view of the entity in the financial statements or, contrariwise, it may be used illegally to intentionally mislead users of financial statements.

Most Ukrainian authors instruct stakeholders to construe creative accounting as a result of accounting policy that paints a picture of the entity in a situation where there is no clearly prescribed method (Pshenychna et al., 2014). Also Russian authors suggest that creative accounting should be treated as a positive phenomenon (Kiz, 2016): according to them, creative accounting is synonymous with accounting innovation, thus divesting it of negative overtones. Kindratska adds that for an accountant to ensure proper presentation of an entity's situation, his creative skills are indispensable.

An entirely different perception of creative accounting is manifest in the Czech Republic and Slovakia, where it is often the subject of master's theses and doctoral dissertations. Some authors suggest that creative accounting is a violation of a true and fair view of accounting, indeed they use the term "manipulation", while others state unequivocally that creative accounting is a kind of fraud (Hamplová, 2015). A large group of authors from Slovakia defines creative accounting in a like way (Holda & Staszel, 2016). However, there are a rare few authors who indicate that accounting freedom can be used in either good or bad faith (Celerýnová, 2015).

6. Definitions of creative accounting in German-speaking countries and Scandinavia

In Germany, Austria, Switzerland, Luxembourg, Liechtenstein, as well as in Norway, Sweden and Finland, the concept of creative accounting is often used in the colloquial sense, however, there is no research into its essence, and likewise there are no research papers reviewing creative

accounting. Single mentions of creative accounting clearly indicate that it is defined only as a negative phenomenon (Bernoth, 2006; Loerwald et al., 2008).

By contrast, in Italy, creative accounting has inspired discussion by accounting theoreticians (Biscotti, 2009). A. Mells (2008) for example cites definitions known to the world literature indicating that a failure on the part of accountants to respect generally accepted accounting principles, or their discretionary interpretation (the author divides creative accounting accordingly) is their common denominator, thus indicating a negative stance on creative accounting.

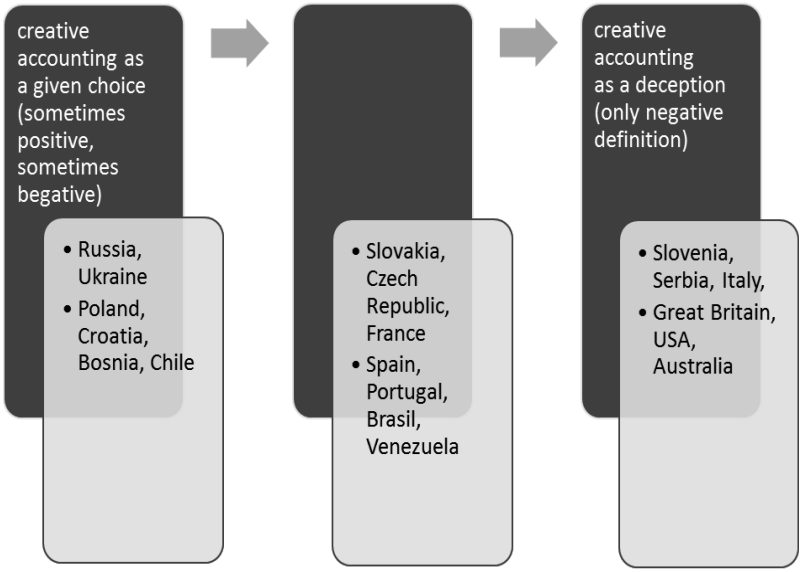
7. Conclusion

In numerous countries of Central and Eastern Europe, the opinion on creative accounting is divided, however, it is possible to discern the prevailing trends in the literature of these countries regarding the definition of creative accounting. Notably, authors in English-speaking countries generally clearly treat creative accounting as a clever form of data manipulation steering the decisions of users of financial reporting.

Analysis of professional accounting literature helps outline how creative accounting is defined by accounting theoreticians in different countries: in some, it is clearly defined as fraud, in others as an ambivalent phenomenon which is simply an operation not directly prescribed by law. In yet other countries, creative accounting is treated as an exclusively positive phenomenon.

Figure 1 presents a classification of different countries depending on the general trend prevailing amongst the authors of the country regarding the definition of creative accounting.

Figure 1. Definitions of creative accounting – classification of different countries depending on the general trend



Source: own elaboration.

It is worth emphasising that international accounting institutions, for example the Chartered Institute of Management Accountants (CIMA), are of the opinion that creative accounting is not synonymous with fraud – it only means solving accounting problems (related to the choice of valuation method, recognition of operations) in a creative, non-stereotypical way. The opinion is shared by most authors from Poland, Ukraine, Croatia, the Czech Republic and Slovakia, who are thus contradict American, English and Balkan authors.

The authors of this paper advocate the following definition of creative accounting: (**creative accounting**) is making legitimate and discretionary choices between various methods of treatment in situations where the relevant norms and standards do not indicate a direct mode of solving a problem or permit alternative approaches (Hołda & Staszel, 2015). In the above definition, creative accounting always means activities in line with the broader law (i.e. criminal, civil, economic, and in particular detailed accounting regulations), and consequently in itself it is not an evaluative concept. In the definition, creative accounting assumes that the criterion of reliability of economic information, and in particular its qualitative characteristics of accuracy, neutrality and completeness, is met (Hołda & Staszel, 2016).

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Chapter 15

Costs of Bankruptcy in the Financial Statements of Companies Listed in the Stock Market[1]

Kinga Bauer

1. Introduction

The financial statement is without doubt the most important report in use in business (Wędzki, 2014, p. 13). The importance of reporting information for early detection of a crisis in a company is also very apparent. The data from the financial statements are the basis for building models of early bankruptcy warnings, both in Poland and around the world. According to research by Smith and Strömberg (2004) financial statements are also used in the process of bankruptcy in many countries. On the other hand, the analysis of documentation, including financial statements of companies undergoing bankruptcy confirm the existence of limited information on the bankruptcy proceedings (Bauer & Toborek-Mazur, 2014). At the same time, the financial statements may be the only source of information for certain groups of stakeholders, who are not able to estimate other factors of success (Baran, 2005). Therefore, it is important that relevant information be presented in a transparent manner.

Bankruptcy costs are one of the major financial categories, the measurements of which should be taken during bankruptcy proceedings. However, research on bankruptcy of companies, including the methods of measurement and presentation of the costs of bankruptcy, is a relatively new field in Poland. At the same time, the possibility to cover the costs of bankruptcy proceedings (which are a part of bankruptcy costs) is a condition that must be met in order for the court to take a decision to declare bankruptcy. Of particular importance is the analysis of the costs of a bankruptcy trial, carried out in the initial stage of the proceedings.

The purpose of this article is to analyze methods of disclosing information on the costs of bankruptcy in the financial statements of companies listed on the Warsaw Stock Exchange. The planned research is to increase knowledge about the steps taken by companies in order to disclose information useful to investors.

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The study included the annual financial statements of companies listed on the Warsaw Stock Exchange, which currently are undergoing bankruptcy proceedings. The research concept is the result of literature studies and the author's own previous research.

2. The essence of calculation of bankruptcy costs

Research on the calculation of costs of bankruptcy proceedings is not new in countries with a developed market economy. Research relates to analyses associated with the measurement of cost amounts, methods of distribution into different categories of costs and their use as measures of effectiveness of bankruptcy systems and procedures (e.g. Gruber & Warner, 1977; Warner & White, 1983; Altman, 1984; Skeel, 1993; Hennessy & Whited, 2007; Newton, 2010).

Interest in bankruptcy costs rises from the fact that, in all bankruptcy systems worldwide, the bankruptcy proceedings are associated with costs. Marsh (2010, p. 45), commenting on the bankruptcy costs in the United Kingdom, wrote explicitly that: "It is ironic, but it is quite expensive to go bankrupt". Initiating bankruptcy proceedings entails advance payments towards the costs of bankruptcy proceedings (Finch, 2012). Where the estimated bankruptcy costs exceed the value of the bankrupt enterprise's assets, this results in dissolution of the company, not the bankruptcy (Altman & Hotchkiss, 2006). In Poland the court shall dismiss the petition to declare bankruptcy when the assets of the insolvent debtor are not sufficient to cover the cost of the proceedings.

In accordance with Smith and Strömberg (2004), bankruptcy proceedings involve costs, both directly related to the bankruptcy procedure as well as indirect ones, e.g., impairment of assets. In their opinion, bankruptcy law should support the effectiveness of the bankruptcy proceedings, i.e., facilitate a quick conclusion of an agreement between the debtor and the creditors. Faster bankruptcy proceedings limit the procedural costs as well as reduce the losses resulting from a decrease in the liquidation value of the bankrupt's assets.

The costs of bankruptcy are a broader concept than the costs of the insolvency proceedings. Chłodnicka (2005, p. 115) defines costs of bankruptcy as: "probable decrease in economic benefits which are of fixed value during a reporting period, causing weakening of the financial situation of an enterprise, that in turn creates additional burdens which determine the future of the bankruptcy process. The burdens take on the form of a reduction in the value of assets or an increase of liabilities or reserves". Research on the costs of bankruptcy is focused mainly on the analysis by direct costs (associated with legal proceedings and bankruptcy) and indirect (i.e. unearned or lost profits as a result of the initiation of proceedings leading to liquidation of the debtor's assets) (Prusak, 2011). Research calculations included the mean and median in relation to the book value of assets of the company in debt or its market value before bankruptcy (Altman & Hotchkiss, 2006). Research conducted in Poland shows that in the process of bankruptcy it is more appropriate to compare the costs of the trial to the estimated value of the debtor's assets. This is justified by both the law and practice of bankruptcy proceedings, in which the basis for the decision to declare bankruptcy is a reference to the estimated value of the debtor's assets (Bauer, 2013a).

The costs of the bankruptcy proceedings, in accordance with applicable law and the logic of the bankruptcy proceedings are divided into the following costs:

- preparatory (reconnaissance),
- the actual bankruptcy trail.

These costs can be assigned to various sections. Chłodnicka (2004) has assigned them based on task:

- the cost of core bankruptcy operations, this includes the valuation of assets, conducing an auction, employee compensation (including charges like allowances, taxes etc.), severance, penalties, damages, fines, bailiffs activities, taxes and donations, etc.,
- the costs of administrative activities during bankruptcy, including the remuneration of the liquidator, the board of creditors, employees hired to fulfill all necessary tasks during the bankruptcy process, the costs of notices and announcements, other administrative costs,
- finance expenses, including interest on debt, judicial interest, administrative, etc.

The costs of bankruptcy should be presented within the framework of cost accounting. Cost accounting is a modern tool of management accounting which, at the time of bankruptcy proceedings, allows you to reduce costs to a level necessary to properly conduct the proceedings. Its correct use can affect the fulfillment of creditors' claims to a greater degree than if it were not used at all (Sojak & Trojanek, 2010).

Research on the information needs of users of financial statements of companies listed on the stock market does not indicate interest in information on bankruptcy costs. However, according to research of D. Dziawgo (2011), investors expect greater transparency and full access to easily understood financial data. They want more accountability and emphasis to be put on the quality of information.

Therefore, bankruptcy costs, which indicate whether it is possible for a company to survive (in the case of proceeding leading to an arrangement) and fulfill creditors' claims should be presented in the financial statements.

3. Chosen aspects of legal basis for cost calculation of bankruptcy

Until the end of 2015 bankruptcy proceedings in Poland could be initiated with the intent to liquidate the assets of the insolvent debtor, or lead to an arrangement. Starting January 1, 2016 the conduction of proceedings with the intent to make an arrangement, which in fact are restructuring proceedings, is regulated by the *Restructuring law*[2]. Due to the fact that judicial insolvency and restructuring proceedings in Poland on average take a few years, the Warsaw Stock Exchange currently lists companies in which the proceedings are being carried out according to both the provisions of *the Bankruptcy and Reorganization Law,* as well as companies in which the proceedings are being conducted according to *the Restructuring Law.*

One of the differences in the approach to the restructuring processes in the new law is no longer calculating the costs of bankruptcy, which were calculated in bankruptcy with possibility to make an arrangement. This approach is consistent with the idea of the new restructuring procedure, the aim of which is to avoid bankruptcy.

On the other hand, one element of the bankruptcy proceedings documentation[3], created to provide information necessary for the court to make a decision to declare bankruptcy, is an analysis

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[2] Doing Business report states that the average duration of bankruptcy proceedings in Poland is 3 years. As of May 20, 2016,7 companies in "arrangement bankruptcy", 3 in "restructuring" and 1 in "liquidation bankruptcy" are listed on the Warsaw Stock Exchange.

[3] The development of analyses of the costs of the bankruptcy proceedings applies to both bankruptcy leading to the liquidation of the debtor's assets, as well as leading to an arrangement.

of costs of the bankruptcy proceedings. This analysis is created in the period between the filing of the request to declare bankruptcy and the court's decision to initiate bankruptcy proceedings or dismiss the claim.

The bankruptcy law does not contain a closed list of expenses, and only mentions examples. The costs of the bankruptcy proceedings include all the essential expenses that are necessary to conduct the bankruptcy proceedings. The purpose of bankruptcy proceedings is not just liquidation of the bankruptcy estate, but also to satisfy, even if to a minimal degree, the claims of creditors (Jakubecki & Zedler, 2010). Therefore, cost analyses of bankruptcy proceedings refer not only to the liquidation of the bankruptcy estate, but also the possibility to cover creditors' claims.

The costs of bankruptcy proceedings are incurred both in the initial stage of bankruptcy proceedings (the so-called reconnaissance costs), as well as during the actual bankruptcy proceedings. In view of the fact that the costs of bankruptcy proceedings are one of the main financial categories used by the court when deciding about the future of an enterprise in debt, it is absolutely crucial for the estimates to be conducted in a reliable manner and not to differ significantly from the costs incurred.

4. Results of latest research on costs of bankruptcy proceedings

Research on the costs of bankruptcy in Poland refer to the costs incurred before filing for bankruptcy, as well as the costs of proceedings.

Chłodnicka and Zimon (2013) conducted empirical studies on the impact of costs on the profitability of an economic entity. The study involved 36 construction companies in Poland. Subject of analysis were the costs of financial distress, which after declaring bankruptcy become bankruptcy costs (symptomatic bankruptcy costs). As a result of research, it was found that symptomatic bankruptcy costs are small (approx. 1% in total costs) and profitability ratios cannot detect upcoming problems. It was also found that symptomatic bankruptcy costs are associated with the threat of loss of liquidity, incurring losses in current business operations and the loss of creditworthiness.

Research is constantly conducted on the economic aspects of bankruptcy proceedings throughout the world, and also in Poland, by the World Bank and the findings are Publisher in Doing Business Report. Doing Business: "studies the time, cost and outcome of insolvency proceedings involving domestic entities. The data are derived from questionnaire responses by local insolvency practitioners and verified through a study of laws and regulations as well as public information on bankruptcy systems. (…) The cost of the proceedings is recorded as a percentage of the value of the debtor's estate. The cost is calculated on the basis of questionnaire responses and includes court fees and government levies; fees of insolvency administrators, auctioneers, assessors and lawyers; and all other fees and costs" (*Resolving Insolvency Methodology*, 2015). Research published in Doing Business Report shows that, the cost of the proceedings in the years 2004-2014 consistently averaged 15% of the value of the debtor's estate (*Report Doing Business*, 2015).

A survey conducted in four courts in Poland under the project "Efficiency of bankruptcy procedures" (Morawska, 2013) shows that bankruptcy costs are 35% of the bankruptcy estate. Data for the study was obtained from trustee final reports or periodic statements of accounts. The results indicate a correlation between costs of the bankruptcy proceedings and the bankruptcy estate. However, in the study sample there were cases in which the costs of proceedings were very high, despite small bankruptcy estate funds. The results confirmed a correlation between costs

of the bankruptcy proceedings and trustee remuneration. Remuneration of the trustee in relation to the costs of the bankruptcy proceedings amounted to an average of almost 5%.

Research on the assessment and presentation of costs of bankruptcy proceedings as presented in the documentation of court proceedings was conducted in Poland (Bauer, 2015). The research focused on the costs of bankruptcy proceedings, but with particular emphasis on the role of court representatives in the cost analysis. Records from 2011 of 100 cases of bankruptcy proceedings in which bankruptcy had been declared were examined. During research it has been found that the current cost analyses are widely used during bankruptcy proceedings, as a basis for the court to make the decision to declare bankruptcy. However, standards of preparation of this type of analyses have not yet been developed, and in turn this affects their detail, quality and in many cases rules out the possibility of their use as a tool to control costs in bankruptcy proceedings. In summary, as result of research, it has been found that, it would be advisable to develop principles for the measurement and – more detailed and transparent – presentation of information about planned and actual revenues and costs in cost accounting of the bankruptcy process. Steps taken in this direction would increase the transparency of the bankruptcy proceedings, and could have a positive impact on the ability to satisfy creditors' claims.

Unpublished research on the disclosure of restructuring proceedings in financial statements of companies listed on the Warsaw Stock Exchange shows that, companies that are in restructuring under insolvency proceedings leading to an arrangement, display information on the costs of bankruptcy proceedings. In two of the six cases, the issue of the costs of ongoing bankruptcy proceedings, the establishment of reserves to cover bankruptcy proceedings or the ability to bear the costs of liquidation in the event of a change in the bankruptcy proceedings was identified.

The results of previous research were a starting point for the next stage of analysis on how the costs of bankruptcy are presented. Research will continue on companies listed on the Warsaw Stock Exchange, as entities in which the transparency of the information published in financial statements is particularly important. Attention will be focused on the placement and level of detail of information on the costs of bankruptcy in the financial statements of companies in liquidation or arrangement.

5. Disclosure practices of bankruptcy costs in the financial statements of companies listed on the Warsaw Stock Exchange

The purpose of research is to analyze the scope of information regarding the costs of bankruptcy disclosed in the financial statements of companies listed on the Warsaw Stock Exchange. In order to do so, the financial statements of all listed companies undergoing bankruptcy proceedings were analyzed[4].

Bankruptcy proceedings are under way in 8 listed companies, including:

- 7 cases of proceedings under "bankruptcy leading to an arrangement",
- 1 case of proceedings under "bankruptcy leading to liquidation".

[4] Data as of 27/05/2016, from the website of the Warsaw Stock Exchange: https://www.gpw.pl/lista_spolek?search=1&query=w+upad%C5%82o%C5%9Bci&country=&voivodship=&sector=&ph_tresc_glowna_offset=0.

Companies listed on the Warsaw Stock Exchange, post their annual, semi-annual and quarterly reports on the WSE website. Where possible, annual reports were selected for research purposes, due to the fact that they are subject to audits. In cases in which annual reports for 2015 were not available, most recent reports posted on the Warsaw Stock Exchange website were selected.

Table 1. Disclosure of bankruptcy costs of companies listed on the Warsaw Stock Exchange

Company name	FS for:	Information on bankruptcy costs	
		positioning	description
ABM SOLID SPÓŁKA AKCYJNA W UPADŁOŚCI UKŁADOWEJ	2015	Introduction to financial statement	Information on the estimated costs of the insolvency proceedings including liabilities, if liquidation of the company occurs
AMPLI SPÓŁKA AKCYJNA W UPADŁOŚCI UKŁADOWEJ	2015	No information available	
B.A.C.D. SPÓŁKA AKCYJNA W UPADŁOŚCI UKŁADOWEJ	2015	No information available	
BUDOPOL-WROCŁAW SPÓŁKA AKCYJNA W UPADŁOŚCI UKŁADOWEJ	3rd quarter of 2015	No information available	
EUROPEJSKI FUNDUSZ HIPOTECZNY SPÓŁKA AKCYJNA W UPADŁOŚCI LIKWIDACYJNEJ	3rd quarter of 2015	No information available	
FOTA SPÓŁKA AKCYJNA W UPADŁOŚCI UKŁADOWEJ	2015	No information available	
IDM SPÓŁKA AKCYJNA W UPADŁOŚCI UKŁADOWOEJ	2015	No information available	
PBG SPÓŁKA AKCYJNA W UPADŁOŚCI UKŁADOWEJ	2015	No information available	

Source: own elaboration based on data included in financial statements of above mentioned companies. Retrieved on 27/05/2016, from https://www.gpw.pl/lista_spolek?search=1&query=w+upad%C5%82o%C5%9Bci&country=&voivodship=&sector=&ph_tresc_glowna_offset=0.

According to research, the theory on bankruptcy costs was not applied to present those costs in the financial statements in any of the examined cases. The idea of bankruptcy costs is a much broader topic than the cost of insolvency proceedings, but even these costs were not presented in the financial statements of companies at bankruptcy. Only one company "ABM SOLID SA in arrangement bankruptcy" reported in its financial statements the potential costs of the bankruptcy proceedings, if there would be a change into liquidation bankruptcy. None of the examined companies provided information on the costs of the bankruptcy proceedings, *ex post*, not even "European Mortgage Fund SA in liquidation bankruptcy" in which bankruptcy proceedings leading to the liquidation of the assets are ongoing.

The results of previous research (Bauer, 2015) indicate that the costs of the bankruptcy process are estimated and analyzed by insolvency practitioners. These costs are reflected in proceedings' documentation. However, as follows from present research, they are not presented in the financial statements of listed companies.

6. Conclusion

The financial statement is still the most important, and often for some stakeholder groups the only source of information about the financial condition of an entity. It plays a significant role in the case of stock market listed companies, because it is used by external investors to decide how to locate their funds.

Investors expect that the financial statement will help to get a clear picture of the risks associated with the business activities of the entity, and therefore allocated funds.

In the case of bankruptcy proceedings, the issue of bankruptcy costs can be significant. In the event of liquidation, it is information for creditors which helps to compare and estimate the possibility to recover funds. In case of bankruptcy leading to an arrangement, the amount of bankruptcy costs may affect the viability of the company.

As indicated by research, stock market listed companies – in most of the studied cases – did not publish in their financial statements information on the costs of bankruptcy, even those related to the ongoing proceedings. Particularly noteworthy is the fact that, only one company in the sample group which was in "in liquidation insolvency" did not provide any information on the costs of insolvency. Only one company identified the estimated costs of the bankruptcy proceedings in the introduction to the financial statements, if case of a change of the proceedings liquidation. The costs of bankruptcy proceedings *ex post* were not provided by any of the analyzed companies.

It should be emphasized that such a situation can be considered valid from the point of view of how the law is implemented, because the sum of these costs may amount to a small value compared to total assets. However, from the point of view of financial statements users of companies with increased risk of bankruptcy[5], widening the range of information on insolvency proceedings ought to be considered appropriate.

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[5] Bankruptcy with possibility to make an arrangement is not tantamount to substantial doubt about the entity's ability to continue as a going concern, but it is evidence of insolvency of an enterprise or it being threatened in the near future, and thus operating at a higher risk.

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Chapter 16

Structure and Security of Accounting Information Systems – A Comparison of Results of Research Conducted in 2005 and 2014/2015[1]

Jan Madej, Katarzyna Szymczyk-Madej

1. Introduction

The paper is based on the results of research studies conducted in 2005, 2014, and 2015, concerning the structure and functioning of accounting information systems (AIS) in companies. The presented issues represent a fragment of the research study, referring to AIS structure and security.

The paper aims to compare the obtained results and present the changes that have occurred in the last decade in AIS systems in terms of their structure and security.

The research study in 2005 was based on questionnaires (193 responses), and concerned the functioning of accounting information systems, with special attention given to internal audits (Szymczyk-Madej, 2005). Another series of studies were conducted in 2014 and 2015, recording 126 responses[2]. All the studies relied on the same sets of questions and two techniques – questionnaires sent by post and e-mails to a randomly selected group of enterprises (which addresses were taken from the base of companies in Panorama Firm), and those passed on by the students of Accounting and Finance post-diploma programs.

Some minor modifications to surveys were due to changes in IT technologies. This mode of research enabled us to collect up-to-date information on the structure, functioning, use and security of contemporary accounting information systems, as well as to compare the obtained results with those based on the studies conducted ten years earlier, leading to the identification of AIS changes in that period.

The results are presented on a percentage basis – the share of a given type of responses in the total number of responses. Because of an extensive range of results, the paper presents only the key

[1] The publication was financed from the statutory research funds of the Department of Accountancy of the Cracow University of Economics.

[2] The results of the 2014 research study and their comparison with 2005 figures in the context of the structure and functioning of accounting information systems are presented in the paper (Szymczyk-Madej, 2014).

conclusions and remarks concerning accounting information systems and their security. Also, for the sake of the clarity of the interpretation of data, the presented conclusions are based on aggregate responses. Two percentage figures in brackets, preceded by "respectively", correspond to the results for 2005, and 2014/2015. Similarly, two values in a given column correspond to the analysed years.

2. The results of research

More than 1/3 of the surveyed companies (34% and 44%, respectively) were small entities (from 1 to 50 employees), nearly half of them (47% and 45%, respectively),medium sized companies (from 51 to 250 employees), while the remaining companies (18% and 11%, respectively) represented large enterprises. The surveyed companies were engaged in services (62% and 63%, respectively), trade (43% and 59%, respectively), and production (34% and 21%, respectively). Half of the surveyed companies (48% and 56%, respectively) were based in cities with more than 100,000 inhabitants. Most of the respondents were directly engaged in company accounting systems – chief accountants, financial directors, or other related staff members (47% and 71%, respectively). Approximately 2/3 of the respondents were female (64% and 69%, respectively). The majority of respondents were aged 31-40 (45% and 36%, respectively).

Responses concerning the structure of accounting information systems indicate that nearly half of companies (47% and 63%, respectively) make use of at least 6 computers in their AIS (Tab. 1). Also, a significant change can be observed in AIS – an increase in the number of computers. Currently, more than 90% of companies use at least 3 computers in AIS.

Table 1. The number of computers in AIS in the analysed companies

Number of computers	Companies (2005)	Companies (2014/2015)
0	0%	0%
1	10%	2%
2	18%	7%
3-5	25%	32%
6-10	19%	26%
More than 10	28%	33%

Source: own study.

Microsoft Windows still ranks first as the most frequently applied operating system (Tab. 2). The most popular system in 2005 – Windows XP (73%) – is replaced by its subsequent versions – Windows Vista/7/8 (88%). Such figures are not surprising, but it should be noted that more than 1/3 of companies (39%) still use Windows XP, which is regarded as obsolete (launched in 2001), and no longer supported by the manufacturer (Microsoft, 2014). Also, Linux gains in popularity (16% and 29%, respectively), which results from its increased use in servers and office work. The popularity of this system in desktops and portable computers results from the positive changes (ease of installation and use, and the increased use of *Open Source*) which have occurred in the recent years in the distribution of this system (GUS, 2011; Linux Survey, 2015; PCWorld, 2013).

Table 2. Operating systems used in AIS in analysed companies

Operating system	Companies (2005)	Companies (2014/2015)
MS DOS	21%	3%
Windows 95/98//ME	37%	7%
Windows NT/2000/2003/2008	32%	20%
Windows XP	73%	39%
Windows Vista/7/8	–	88%
Linux	16%	29%
other	2%	1%

Source: own study.

The headcounts of accounting departments, i.e. the staff who use AIS, do not change considerably in the analysed period. Approximately 1/10 of companies (11% and 15%, respectively) employ only one worker, while half of businesses (50% and 44%, respectively) employ at least 6 people. The headcounts of IT departments do not record significant changes – in the particular categories not exceeding 5%. Currently, 1/5 of companies (16% and 20%, respectively) do not employ IT specialists (not even on a contracted work basis), and 1/3 of entities (29% and 35%, respectively) employ one person in this position. However, half of companies employ two or more IT specialists. The distribution of employees in accounting and IT departments is presented in Table 3.

Table 3. The number of staff in accounting and IT departments in analysed companies

Staff	Number of employees											
	0		1		2		3-5		6-10		> 10	
	2005	2014/15	2005	2014/15	2005	2014/15	2005	2014/15	2005	2014/15	2005	2014/15
employees of accounting departments	0%	0%	11%	15%	19%	23%	19%	18%	26%	27%	24%	17%
IT specialists in companies (employment contract or contracted work)	16%	20%	29%	35%	21%	25%	20%	12%	11%	6%	3%	2%

Source: own study.

The further analysis of data indicates, as expected, that the majority of companies which do not employ IT specialists represent the sector of small businesses (87% and 92%, respectively), and they usually employ one person in charge of accounting. Large companies possess the most advanced IT systems, equipped with more than 6 computers (88% and 97%, respectively), and nearly all of them employ more than 6 people in their accounting departments (96% and 100%, respectively), and at least 3 IT specialists (98% and 93%, respectively).

Generally, the structure of accounting information systems and the number of accounting and IT staff in the analysed companies are as expected. The size of AIS and the number of staff are dependent on company size, and no significant changes are recorded in this area during the analysed years.

The responses regarding the origin of software and the use of available IT systems indicate that AIS is used in all companies for accounting purposes (Tab. 4). Moreover, the system is used for managing compensation systems (95% and 93%, respectively), HR-related issues (81% and 89%, respectively),as well as sales processes (76% and 84%, respectively). These areas are traditionally associated with the use of AIS, so the obtained data are not surprising. Over the years, the extent of AIS applications has not changed. On the other hand, the use of AIS has increased in office work (72% and 100%, respectively) and bank transfers (68% and 99%, respectively). It implies that even small companies resort to business operation remote technologies.

Regrettably, a relatively small percentage of businesses make use of AIS for carrying out financial analyses (43% and 38%, respectively) despite the fact that even basic accounting software facilitates such operations.

Table 4. The use of AIS in analysed companies

The use of the system	Companies (2005)	Companies (2014/2015)
accounting	100%	100%
HR	81%	89%
payroll	95%	93%
procurement	43%	65%
sales	76%	84%
fixed asset management	67%	88%
warehousing management	48%	43%
financial analyses	43%	38%
office work	72%	100%
bank transfers	68%	99%

Source: own study.

The obtained results indicate (Tab. 5) that the overwhelming majority of software programs are standard products available in the market (81% and 97%, respectively). Simultaneously, in the recent years the number of customized programs has tended to decrease in favour of standard commercial software (FK, 2014). Such software is commonly used in small companies (91% and 97%, respectively), which confirms the results of studies conducted by other authors (see: Jaworski, 2011).

Responses in 2005 are similar in terms of the use of AIS systems and their customization (Tab. 5). 3/4 of respondents declare a very large or large extent of the use of these systems and their customization. The limited use of programs and their customization is declared by less than 1/10 of respondents (similar results are presented in other studies – (KP, 2013)). Interestingly, such views are more frequently held by respondents from large companies. It can be attributed to much more advanced IT systems in these companies (offering a number of functionalities that are not used) as well as the users' greater demand for various system functionalities and resulting deficiencies with regard to adjusting programs to their specific needs.

Table 5. The origin and extent of use of AIS programs in analysed companies

AIS programs in companies ...	yes (all of them)		most of them		some of them		no (none)	
	2005	2014/15	2005	2014/15	2005	2014/15	2005	2014/15
are customised (adapted) – developed by full-time IT specialists or external companies	4%	0%	14%	3%	26%	18%	55%	79%
	to a very large degree		to a large degree		to a moderate degree		to a small degree	
are used to their full potential (all functionalities)	27%	19%	44%	38%	22%	34%	7%	9%
are adjusted to specific needs (sufficiently productive, efficient, etc.)	15%	10%	58%	46%	18%	40%	9%	4%

Source: own study.

This situation changed in 2015. The percentage of respondents declaring a very large or large degree of the use of programs decreased (71% and 57%, respectively), which is also true of the degree of customization (73% and 56%, respectively). In the context of the previous responses concerning a large share of standard programs, it can be attributed to the fact that universal programs are characterised by numerous, and frequently advanced functionalities, which are not used.

The obtained results concerning HR policies are presented in Table 6.

Table 6. HR management – AIS employees

AIS employees are ...	always (yes)		frequently (most of them)		rarely (some of them)		never (no)	
	2005	2014/15	2005	2014/15	2005	2014/15	2005	2014/15
trained in performing their functions on a regular basis (operating programs/equipment)	18%	12%	34%	31%	38%	50%	9%	7%
have easy access to instruction manuals (programs and equipment)	31%	37%	37%	39%	17%	20%	14%	4%
well acquainted with their scope of work, authority and responsibility	53%	53%	29%	34%	15%	12%	4%	0%
directly managed by their superiors	53%	54%	22%	19%	15%	17%	9%	10%

Source: own study.

The analysis points to great deficiencies in the area of training staff in performing their functions and operating software and equipment. The results for 2005 and 2014 are similar. Respondents from more than half of companies state that staff are rarely trained, or not trained at all (47% and 57%, respectively). More positive responses relate to access to instruction manuals – only 1/4

of respondents (31% and 24%, respectively) assess this area in a negative way. Responses are much more positive with respect to employees' knowledge of their tasks, authority and responsibility – more than 3/4 of them state that all staff members, or most of them, are well acquainted with those issues.

A similar proportion of respondents believe that they are (always or frequently) directly supervised by their superiors. It should be noted, however, that as many as 1/10 of respondents (9% and 10%, respectively) state that their work is not supervised.

Responses related to AIS security are presented in Table 7. They indicate that the situation in this area is satisfactory. In both surveys, 3/4 of respondents almost always or frequently make use of approved programs (78% and 92%, respectively), their computers are protected by passwords (75% and 83%, respectively), physical access to computers and documents is protected (82% and 81%, respectively), and they copy data on a regular basis (83% and 92%, respectively). The protection of workstations also seems to be satisfactory (66% and 77%, respectively). However, systems for protecting IT systems in companies should never fail. In reality, in 1/10 of companies computers and documents can be accessed by unauthorised personnel, and computers are not protected by passwords.

Table 7. The protection of AIS data and software in analysed companies

In a company ...	yes (always)		most of them (frequently)		some of them (rarely)		no (never)	
	2005	2014/15	2005	2014/15	2005	2014/15	2005	2014/15
staff only use software approved by superiors and IT specialists	69%	76%	9%	16%	13%	8%	9%	0%
computers are protected by passwords	65%	62%	10%	21%	14%	9%	12%	9%
only authorised personnel have access to computers and documents (offices in which they are placed)	47%	40%	35%	41%	6%	8%	12%	10%
employees protect their workstations (switch off computers, lock rooms)	42%	37%	24%	40%	15%	19%	19%	4%
data are copied, filed and stored on a regular basis	67%	80%	16%	12%	14%	6%	4%	2%

Source: own study.

Respondents were also asked to assess the particular components of AIS and IT security systems. The results are presented in Table 8. They indicate that in both surveys 3/4 of companies regard their security systems to be satisfactory. In some cases – over the period of 10 years – a given security component has gained in significance. For example, 3/4 of companies regard the observance of security regulations as at least satisfactory (72% and 80%, respectively), protection against accidents (77% and 81%, respectively), physical protection of computers, offices and documents (78% and 85%, respectively), and emergency procedures (71% and 69%, respectively). A considerable increase is recorded in anti-virus and preventive measures (86% and 99%, respectively), and the protection of documents, files and data storage media (74% and 91%, respectively).

A smaller proportion of respondents (half of companies) regard their security organizational solutions to be at least satisfactory (61% and 62%, respectively), and security awareness and

trainings (55% and 54%, respectively). Interestingly, security levels in this area have not changed in the recent years.

Table 8. AIS security levels in analysed companies

Type of protection	very good, good		satisfactory		unsatisfactory		none	
	2005	2014/15	2005	2014/15	2005	2014/15	2005	2014/15
security organizational solutions (regulations, guidelines)	19%	23%	42%	39%	26%	22%	14%	16%
emergency procedures	21%	25%	50%	44%	11%	17%	17%	13%
employee trainings (awareness) in security and system protection	26%	23%	29%	31%	27%	31%	18%	15%
employees' observance of protection and security regulations	25%	28%	47%	52%	18%	15%	9%	6%
anti-virus control and preventive measures (the use of anti-virus software)	64%	81%	22%	18%	11%	2%	4%	0%
protection of documents, files and data storage media (also used ones)	52%	62%	22%	29%	19%	7%	6%	3%
protection against emergency conditions (e.g. thefts, fire, power failure)	55%	62%	22%	19%	15%	13%	7%	6%
physical protection of computers, offices and documents (e.g. alarms, window bars and safes)	45%	58%	33%	27%	14%	9%	8%	5%

Source: own study.

Generally, differences in results for 2005 and 2014/2015 do not exceed 10%. The further analysis indicates, as expected, that small companies are characterised by the lowest quality of AIS protection and security systems. The results for medium and large businesses are comparable.

Similarly to the interpretation of the results presented in the previous Table, these issues relate to the security and protection of systems. Despite the seemingly favourable proportions, the obtained results indicate that in 1/4 of companies (or nearly half of them in the case of organizational solutions and trainings – 40% and 38%, and 45% and 46%, respectively) the level of protection systems is not satisfactory, or some components of such systems do not exist. For example, the employees of 1/4 of companies do not follow protection and security regulations in a satisfactory manner (27% and 21%, respectively), and companies do not apply emergency procedures (28% and 30%, respectively). Simultaneously, a positive trend can be observed – a decreasing number of companies with unsatisfactory anti-virus control and preventive measures (from 15% to 2%), the protection of documents, files and data storage media (from 25% to 10%), and physical protection of computers, offices and documents (from 22% to 14%).

3. Conclusion

The analysis of the results of research studies conducted in 2005 and 2014/2015 lead to the general conclusion that the functioning of IT systems in companies in the last decade has not undergone any significant changes. The visible changes in the structures of accounting information systems include an increased number of computers used in such systems, and a greater share of standard commercial software. Visible changes are recorded in AIS security, although they are not global in character and do not relate to all security aspects.

The comparison of results allows for identifying the following positive trends:

- a broader use of accounting information systems, especially in office work and bank accounts,
- easier access to software documentation,
- higher levels of the use of protection measures, especially with regard to anti-virus control and preventive measures.

Nevertheless, some negative phenomena still occur including the following:

- the use of obsolete, no longer developed operating systems,
- insufficient trainings in the functioning and security of systems and operating equipment and software,
- problems faced by small and medium companies in the area of the availability of IT services and the application of particular protection measures,
- deficiencies in security organizational solutions, emergency procedures and employees' observance of protection regulations.

The analysis of positive and negative trends leads to the conclusion that major improvements in AIS are introduced in the areas directly related to the development and application of information technologies. Negative trends, on the other hand, mainly result from the lack of organizational solutions. Therefore, this area of activity requires large-scale improvement.

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Chapter 17

Application of Communication in its Electronic Form as a Catalyst of the Evolution of Formal Solutions in Report Making

Michał Baran

1. Introduction

The dynamic civilization development, initiated in the second half of the 20th century and designed to arrive at the optimal exploitation of the man-possessed information resources is the phenomenon of ever growing significance. This is so because the attention was drawn to the scale of the earlier ignored advantages that might be derived from the aforementioned resources exploitation. In addition, the basic reserves – relying on simple exploitation of resources – that supported the development of companies, or the entire economic sectors or even the respective economics in particular countries have already been exhausted. The progress that is observed in our days is performed through complicated organizational changes and it forces the governing structures to apply multi-dimensional and compound harmonization involving coordinated human activities as well as flexibility of reactions and the making of analysis of extensive sets of data, the analysis being made with the use of information technology. No wonder, therefore, that one of the visible effects of the information revolution is the ever more prevalent migration toward the virtual space of all ties and dependencies that are present in the real world. This allows to integrate the independent organizing systems, construed for various purposes and in variety of ways but – within a certain area – linked by a joint drive (even if simultaneously the major aims that these systems pursue contradict one another). The larger entirety emerging therefrom allows to reach the effect of synergy. This is due to the progressing standardization and the facility in cooperation in cases when the latter is indispensable. Thus – in accordance with the aforementioned universally observed tendencies – the contact between the economic units and the agencies (offices) that surround them follow the pattern described above, i.e. also in their case it is possible to observe the symptoms of the discussed processes. This provokes the reflexion on the nature of the occurring changes. In this context, cognitively valuable seems to be the verification of the thesis that frequent reaching out for the already widespread solutions in the area of electronic communication is conducive toward the openness and acceptance of the foreseeable further deeping of virtualization of the relationships between the economic units and the agencies with which they are related. The results

of the questionnaire-based research, as invoked in the present contribution, allow to depict the extent to which the communication in the electronic form is conducive toward creating the climate that is advantageous to the implementation of the successive innovatory proposals.

2. Background

The embarking upon the subject of electronic communication – viewed as the factor that facilitates the implementation of technological solutions in the information reporting – was based on the belief that while exploring it we deal with a certain type of catalyst of changes. The information which is of good quality (i.e. the one that is updated, reliable, exhaustive etc.) is a key factor needed to make a right assessment of the situation of company (Borowiecki et al., 2001) since it allows all the interested parties to better comprehend and assess the actual facts and consequently take optimal decisions (Smoląg, 2015). What is at stake in this case is both the internal aspect of the problem as well as the relationships of the unit in question with its environment (Jaki, 2008). There is a common belief that these are exactly the companies which are active in the e-economy zone that are on the winning side in obtaining the competences that are most searched for and which, at the present day market conditioning, may build up their strong competitive position (Jelonek, 2003). There exist strong premises that allow us to believe that the exchange of internal information made by the use of net multimedial technics is responsible for the univocally advantageous effects (Kiełtyka & Kobis, 2008). When viewed from a broader perspective it is the economic calculus that favours the observed process of multi-dimensional and environment-oriented virtualization (Kiełtyka & Kobis, 2013). In this context a particular role falls to the solutions based on the use of the internet potential (Lisowska & Rotalewska, 2012). It is exactly in the sphere of carrying out the tasks within the scope of conducting the book-keeping for the economic entities that this phenomenon is also strongly visible (Bauer & Baran, 2015). All the aforementioned elements make up a coherent whole illustrative of the mutual relationship between the electronic exchange of information and the creation of the conditions conducive toward the gradual building up of the market dominance (Łobos & Pypłacz, 2015). Consequently, all the factors that are stimulative of this type of activities should – on the basis of the available knowledge – be considered to be positive and desirable M. Dudek, J. Sobczak and P. Ziętara (2015).

The correct organization of the system within which the reporting as rendered by the economic units is performed means the creation of protection from the potential and manifold disadvantageous phenomena that are characteristic of the units functioning in the public sector (Ziębicki, 2012). The present day bureaucratic apparatus becomes ever more professional. It improves the efficiency and effectiveness of its activities, thereby following the patterns derived directly from the business environment (Ćwiklicki, 2015). A specific keystone linking the public administration sphere and the companies that conduct the commercial activities are doubtless the advisory firms. In the context of the discussed topic we may say that what is at stake at this point is in particular the transfer of knowledge in the area of questions of finance and book-keeping (Kulej-Dudek & Kiełtyka, 2007) and also the spread of the application of informatics technologies (Marecki & Grabara, 2005). What emerges therefrom is a broad civilization context in which the phenomena of synergy that result in an increased development rely upon the social desire to inter alia reaching out for the available solutions within the scope of informational and informatics technologies (Bartkiewicz et al., 2009). In the informational society the dilemma does not refer to whether

certain solutions should be applied but rather to whether, due to their being applied, it is possible to arrive at larger results (Zieliński et al., 2010).

There obviously exist also the rationally justified barriers preventing the reaching out for the most recent technological solutions (Surówka-Marszałek & Śmigielska, 2009). However, when we are concerned with the question of adapting certain solutions to the reporting apparatus, we speak – by reason of natural delays in the adaptation processes – of the technologies that are already thoroughly verified and previously well known in the business milieu. This obviously requires also an adequate evolution of competence of those employed in the appropriate agencies (Czekaj & Jabłoński, 2009). It is obvious that due to payment possibilities, the most competent specialists choose their career beyond the public administration, yet – in due measure, when the specific technologies spread there grows also the availability of trained staff. The specificity of the book-keeping services consists inter alia in this that these services are often rendered along the lines of outsourcing model since this brings advantages to the entities that are determined to select this model of cooperation (Nesterak & Hobora, 2004). This allows for more efficient mastering of useful competencies by those who render the aforementioned services because they select a narrow profile of the chosen specialization. The openness and innovative attitude make up an indispensable factor in improving the conducted activities (Różański, 2014). At present this is the IT sector that is the natural base in which there occurs the search for the new possibilities of development of the economic organizations and economic systems (Kucęba et al., 2013).

3. Method

The questionnaire-based research was made in 2015 on the sample of 114 self-dependent accounting bureaus that had their seats in southern Poland. In the module that is the basis of the presented analysis the following leading questions were formulated:

- whether while contacting – on behalf of your clients – the appropriate agencies you reach out for the possibility of communicating with them by electronic mail? (possible answers: always; frequently; sometimes; rarely; never; I do not know).

It was through the prism of the answers obtained to the above-posed questions that the following issues were analysed:

- whether in the oncoming two years you expect that the successive areas of your obligatory (compulsory) contacts with the appropriate agencies will be covered by the electronic information exchange? (possible answers: decidedly yes; rather yes; I do not know; rather not; decidedly not),
- whether in the oncoming two years you expect that the successive areas of your optional (voluntary) contacts with the appropriate agencies will be covered by the electronic information exchange? (possible answers: decidedly yes; rather yes; I do not know; rather not; decidedly not),
- whether the gradual broadening of the scope of electronic communication with the appropriate agencies, as performed within the frame of contacts of obligatory (compulsory) nature, is – when viewed from your perspective – advantageous and facilitating the conducting of your activities? (possible answers: decidedly yes; rather yes; I do not know; rather not; decidedly not),

- whether the gradual broadening of the scope of electronic communication with the appropriate agencies, as performed within the frame of contacts of optional (voluntary) nature, is – when viewed from your perspective – advantageous and facilitating the conducting of your activities? (possible answers: decidedly yes; rather yes; I do not know; rather not; decidedly no).

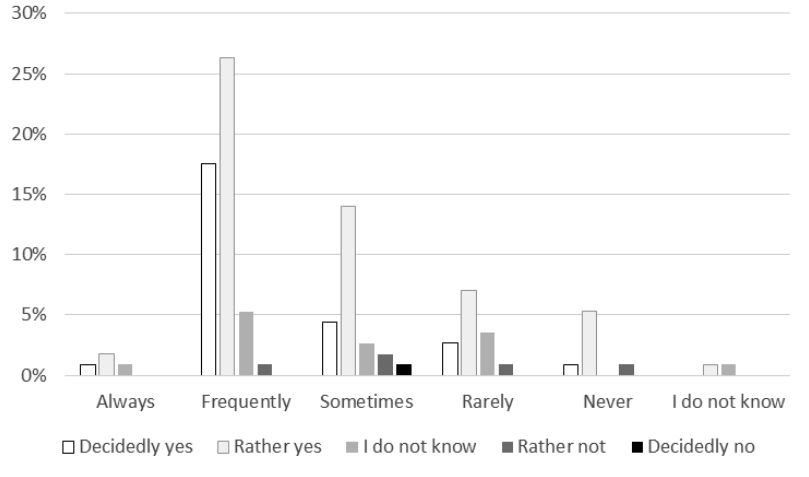
4. Results

Table 1. The scale of the use (on behalf of the clients) of electronic mail in official matters by the accounting bureaus [the lines] in the context of their expectations vis-à-vis the possibility that the successive areas of communication would be covered by the obligation to apply the electronic form [the columns of figures]

	Decidedly yes	Rather yes	I do not know	Rather not	Decidedly no
Always	1%	2%	1%	0%	0%
Frequently	18%	26%	5%	1%	0%
Sometimes	4%	14%	3%	2%	1%
Rarely	3%	7%	4%	1%	0%
Never	1%	5%	0%	1%	0%
I do not know	0%	1%	1%	0%	0%

Source: own work.

Figure 1. The scale of the use (on behalf of the clients) of electronic mail in official matters by the accounting bureaus [the horizontal axis] in the context of their expectations vis-à-vis the possibility that the successive areas of communication would be covered by the obligation to apply the electronic form [the vertical axis]



Source: own work.

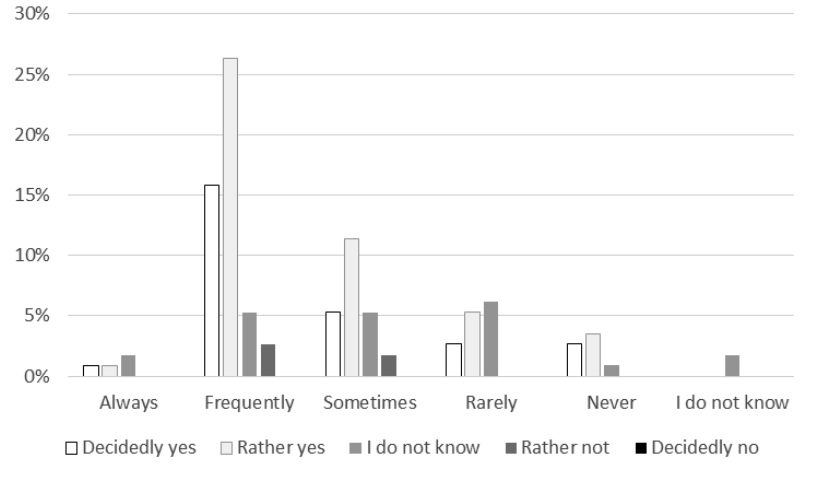
While analysing the use by the accounting bureaus (on behalf of the client) of the electronic mail in the context of the bureaus' expectations to include the new communication areas within the obligatory applying of electronic form, we observe the dominant position of one set of answers. Those declaring frequent reaching out for the electronic form of contact (decidedly yes or rather yes) hope for the successive extension of this kind of obligatory communication. This group makes up 44% of respondents but if we include among them those who select the sometimes option the group would grow to 62%.

Table 2. The scale of the use (on behalf of the clients) by the accounting bureaus of electronic mail in official matters [the lines] in the context of the bureaus' expectations for the further extension of the possibility of applying the electronic form to new areas of communication [the columns of figures]

	Decidedly yes	**Rather yes**	**I do not know**	**Rather not**	**Decidedly no**
Always	1%	1%	2%	0%	0%
Frequently	16%	26%	5%	3%	0%
Sometimes	5%	11%	5%	2%	0%
Rarely	3%	5%	6%	0%	0%
Never	3%	4%	1%	0%	0%
I do not know	0%	0%	2%	0%	0%

Source: own work.

Figure 2. The scale of the use (on behalf of the clients) by the accounting bureaus of electronic mail in official matters [the horizontal axis] in the context of the bureaus' expectations for the further extension of the possibility of applying the electronic form to new areas of communication [the vertical axis]



Source: own work.

The study of the collected declarations with respect to the use (on behalf of the clients) by the accounting bureaus of electronic mail in official matters, and with respect to the bureaus'

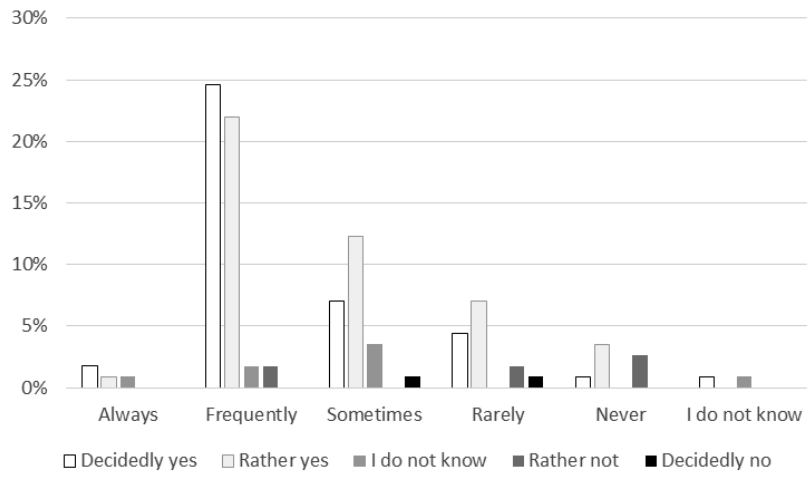
expectations for the extension of the possibilities of applying electronic form of communication, allows to diagnose the picture that is particularly close to the one obtained in the previous outlay. However this time the assessment is subject to larger dispersion. As a result of the latter the groups that can be analogously distinguished represent correspondingly 42% and 58% of the entire investigated body of units.

Table 3. The scale of the use (on behalf of the clients) by the accounting bureaus of electronic mail in official matters [the lines] in the context of the bureaus' assessment of advantages arising from the obligatory cases of applying this form of communication [the columns of figures]

	Decidedly yes	**Rather yes**	**I do not know**	**Rather not**	**Decidedly no**
Always	2%	1%	1%	0%	0%
Frequently	25%	22%	2%	2%	0%
Sometimes	7%	12%	4%	0%	1%
Rarely	4%	7%	0%	2%	1%
Never	1%	4%	0%	3%	0%
I do not know	1%	0%	1%	0%	0%

Source: own work.

Figure 3. The scale of the use (on behalf of the clients) by the accounting bureaus of electronic mail in official matters [the horizontal axis] in the context of the bureaus' assessment of advantages arising from the obligatory cases of applying this form of communication [the vertical axis]



Source: own work.

The comparison of the scale of use (on behalf of the clients) by the accounting bureaus of electronic correspondence in official matters with the bureaus' assessment of advantages assigned to obligatory cases of applying this form of communication allows to perceive one strong shift that is one-sidedly oriented. Those who frequently use the analysed solutions are also convinced about

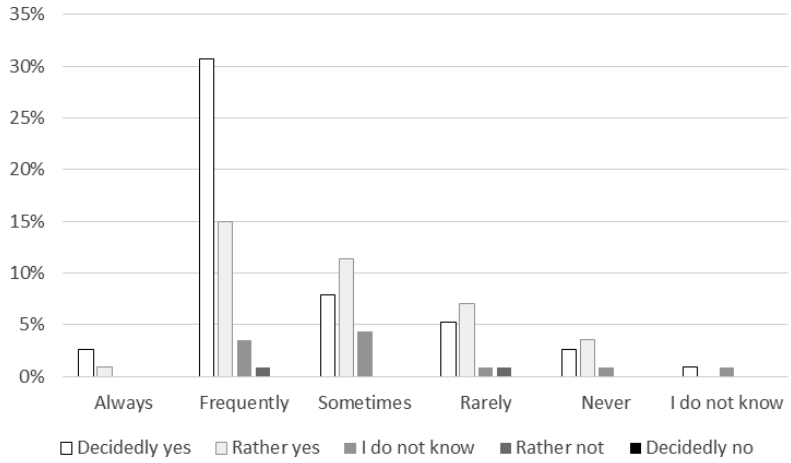
the advantages arising from their obligatory use. While treating jointly the answers: decidedly yes and rather yes, we obtain as many as 47% of respondents and when we integrate with them those who selected the sometimes option, the number of respondents answering in the described way would grow to 66%.

Table 4. The scale of the use (on behalf of the clients) by the accounting bureaus of electronic mail in official matters [the lines] in the context of the bureaus' assessment of advantages arising from the possibility of applying this form of communication [the columns of figures]

	Decidedly yes	**Rather yes**	**I do not know**	**Rather not**	**Decidedly no**
Always	3%	1%	0%	0%	0%
Frequently	31%	15%	4%	1%	0%
Sometimes	8%	11%	4%	0%	0%
Rarely	5%	7%	1%	1%	0%
Never	3%	4%	1%	0%	0%
I do not know	1%	0%	1%	0%	0%

Source: own work.

Figure 4. The scale of the use (on behalf of the clients) by the accounting bureaus of electronic mail in official matters [the horizontal axis] in the context of the bureaus' assessment of advantages arising from the possibility of applying this form of communication [the vertical axis]



Source: own work.

The comparing of the scale of the use (on behalf of the clients) by the accounting bureaus of the electronic correspondence in official matters and the bureaus' assessment of advantages arising from the very possibility of reaching out for certain solutions, shows even more intense strengthening of the tendency observed already earlier. This is particularly visible when the individual results are subjected to analysis. What is disclosed on such occasion is the lean toward the extreme assessments. The group that independently dominate (31%) over other groups is made up of the respondents who frequently reach out for the electronic mail and who are decidedly

convinced about the potential advantages that are made available due to the opening of successive options in the field of reaching out for the solutions which rely on the most recent telecommunications technologies.

5. Discussion

The research that was made allowed to indicate the group of units that distinctly stood out against the background of their entire corpus. The specificity of the group consisted in the frequency with which the latter – while rendering their services to the clients – reached out for the electronic mail in its contact with the appropriate agencies. The respondents that the group included declared that they often or – should the occasion arise – sometimes exploited the electronic mail. Simultaneously this group proved to be cohesive in their assessment referring to their perception of foreseen obligations and the possibilities of reaching out for the electronic technology in the information exchange. Likewise, the group proved cohesive in the perception of advantages arising from so oriented development of principles of cooperation with the appropriate agencies. There is a great probability that, in this respect, the experience acquired by the investigated units is positive. This causes that in their case there is detectable a firmly-grounded conviction that the discussed units would successfully cope with the successive challenges of this kind. The acquaintance with the new reality, reduction of the level of uncertainty, and the development of the possessed competences, lead to the elimination of faint-hearted defensive reactions and the resistance – undertaken just in case something happens – to the potential changes. This allows the discussed units to subject the implemented technologies to thoughtful, rational analysis as well as to collect and consequently thoroughly weigh all significant pros and cons. Admissible is obviously also another interpretation of the collected data. Thus for instance one might claim that the respondents who already earlier were convinced about the need to apply modern telecommunications solutions (in all aspects of their activities), could reach out for the electronic mail in their contacts with the appropriate agencies as soon as such possibility appeared. It seems however that the first interpretation describes the reality with larger probability. It is justified therefore to expect a positive reaction of a pretty large number of economic units toward further progress of virtualization carried out through extension of electronic information exchange with the appropriate agencies. In the light of the observations that have been made, also those respondents who dispose of lesser experience in exploiting the discussed technology should, in their majority, adopt positive attitude toward the problem as they acquire their experience in this field. All forms, therefore, that prove stimulative of the activities in applying electronic mail lead to the rise of catalyst of the further, bilaterally advantageous virtualization of relationships between the economic units and the administrative units.

6. Conclusion

In the light of the above discussion it should be acknowledged that there is a truth in the thesis which was set forth at the outset and which proclaimed that the frequent reaching out for the widespread solutions in electronic communication promotes openness and acceptance of the foreseen further deepening of virtualization of relationship between the economic units and the appropriate agencies. What testifies to this is the identity of, on one side, the declared tendency to the reaching out for the electronic mail form and, on the other, the expectations vis-à-vis further progress

of virtualization, and also the identity of assessment of advantages accompanying the virtualization. Hopefully such attitude will be transformed into the factual level of acceptance of the solutions which will be implemented.

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Chapter 18

Dilemmas over Valuation of Intellectual Property Rights in an Accounting System

Marek Mikosza

1. Introduction

In today's free market economy, both on an international and national scale, an increase in the importance and value of intangible assets may be observed. Simultaneously, ever more frequent transactions concerning intangible assets raise the question about the value of such assets and how it can be estimated.

Since the beginning of the 1990s, owing to the transition of the Polish economy to a free market system, the share of intangible assets in the balance sheets of Polish enterprises has been gradually and continually increasing. Further to this, it has been increasingly more important to work out a methodology for estimating the fair market value of such assets. The lack of material designatum is a specific characteristic of intangible assets. That elusiveness and frequent indefiniteness of a given component of assets create an additional difficulty, i.e. prior to the commencement of a proper valuation, the subject matter must first be defined as precisely as possible. Such complications are not present in the case of assets that have a material designatum, i.e. real estates, process lines, warehouse inventories, etc.

Undoubtedly, arbitrariness may not, however, rely on complete discretion. Valuation may not be detached from standards and good practices (methodology) that have been developed over years, either. In the event whereby valuation is not calculated under the conditions of an arm's length transaction, but is prepared unilaterally by an expert who has been commissioned by an interested entity, it is important that its outcome is verifiable, and the applied methodology is transparent. Experience shows that, in most cases, when there are no conditions for market verification of the valuation results, its correctness is ultimately verified by a public authority, such as a court or tax office.

The hitherto experience proves that it is not possible to determine an absolutely unambiguous value for a specific item of intangible assets. The application of various methods consequently brings about a somewhat different result. Moreover, in the majority of cases, the value of intangible assets changes considerably over time. Thus, results obtained from the valuation may differ significantly, depending on the date when it was carried out.

The purpose of this paper is to review the most frequently applied valuation methods for intangible assets with regard to transactions among affiliated entities. It is also worth stressing that, besides tax law and accounting, there is basically no normative guidance in the Polish law as to the ways of determining the value of intangible assets. Consequently, the methodology defined in the tax law, and particularly in the Regulation of the Minister of Finance and in Article 25a section 1 of the Act on Personal Income Tax may also be successfully applied in the valuation of intangible assets prepared for purposes other than those related to taxes, e.g. for the purposes of contributions in kind, transactions, the establishment of collateral, and the broadly understood fair value.

2. Essence and Classification of Intangible Asset Items

Article 3 section 1 point 14 of the Accounting Act stipulates that intangible assets shall be understood as economically usable proprietary rights, acquired by a given entity and classified as fixed assets, having an anticipated economically useful life of more than one year, that are intended to be used for the entity's purposes, and in particular:

- copyright and neighbouring rights, licenses, and concessions,
- rights to inventions, patents, trademarks, utility and decorative designs,
- know-how.

Furthermore, the provision also stipulates that the acquired goodwill and the costs of completed development works shall be classified as intangible assets. In the International Accounting Standards (Standard 38) an intangible asset is a non-monetary asset that is without physical substance and identifiable.

Having compared the definitions above, the following conclusions may be drawn. First, the Accounting Act defines intangible assets in a narrower way, since it requires a larger number of conditions to be satisfied in order to classify specific resources into this category. Detailed differences in the recognition of intangible assets between the definition offered in the Accounting Act and that of IAS38 have been presented in Table 1.

Table 1. Intangible assets according to IAS 38 and the Polish Accounting Act

As defined by the Accounting Act Intangible assets are resources that:	**Intangible assets as defined by IAS (Standard 38):**
• are property rights, • are acquired (purchased, received free of charge or contributed – with the costs of completed development works being an exception), • have an anticipated economically useful life that is longer than one year, • are economically usable, • are to be used for the purposes of the entity that has acquired them.	• are identifiable, • are non-monetary, • are without physical substance, • are economically usable, • are to be used for the purposes of the entity that has acquired them.

Source: own compilation.

The basic criterion of identifiability constitutes the possibility of explicit separation of benefits derived from a specific intangible asset and economic benefits derived from other assets.

The controllability of a specific asset is an additional criterion for determining the identifiability of a given asset. Namely, access to a specific asset and the possibility of using it by other enterprises must be limited. Thus, other entities should be legally or factually limited in using a given asset. By way of example, exclusive rights, such as patents, rights resulting from the registration of industrial designs or protective rights for utility designs or trademarks, similarly to copyright, shall award the eligible holder of such rights (beneficiary) with a legal monopoly of using their subject, that is a relevant invention, industrial design, brand (logo), work (piece), etc. However, in the case of *know-how*, a physical constraint[1] exists in accessing its subject, since, as a rule, the content of *know-how* is classified and constitutes a business secret. Therefore, with regard to this class of intangible goods, limiting access for other enterprises constitutes not so much a legal monopoly, but secrecy and the lack of access to certain information, for example, of a technological, organisational or commercial nature.

When an intangible asset is recognised, it simultaneously requires classification. This may be performed on the basis of various criteria. The most important ones include:

- **ownership title** (own intangible assets, foreign intangible assets subject to accounting recording pursuant to similar rules, as in the case of own intangible assets, and foreign intangible assets that are recorded off-balance sheet),
- **intended purpose of use** (production intangible assets, used for the purpose of supplies, manufacture and sale, and non-production intangible assets used for general management and social purposes),
- **type** (proprietary rights, other rights, *know-how*, the costs of completed development works and goodwill),
- **economic/legal content** – outlay for development works incurred over a period, special category, positive goodwill, etc.

In practice, the most frequent example of mistakes in identifying intangible assets involves OEM computer software licences (licences granted for a specific device, identifiable with a serial number, a manufacturer's number, or otherwise). Such licences increase the value of the fixed asset on which they have been installed, since, individually, they do not meet the condition of identifiability" (Walińska, 2009).

3. Valuation of intangible assets in business

An indispensable element for defining is the value that is calculated in the valuation process. In this area the definitions included in the International Financial Reporting Standards and in the Accounting Act may also serve as a benchmark. IFRS 13 defines fair value as an amount for which a given asset could be exchanged between willing and informed, independent and equal parties in an arm's length transaction.

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[1] There is a discrepancy in the doctrine whether know-how constitutes a proprietary right or whether it is rather a factual status which is legally protected and the violation of which is a tort. Cf. A. Michalak [in:] M. Zdyb, M. Sieradzka, A. Michalak, M. Mioduszewski, J. Raglewski, J. Rasiewicz, J. Sroczyński, M. Szydło & M. Wyrwiński (Eds.), (2011). *Ustawa o zwalczaniu nieuczciwej konkurencji. Komentarz [Act on Combating Unfair Competition. Commentary]*, System informacji prawnej [legal information system] LEX.

The Accounting Act, in turn, provides that fair value shall be the amount for which an asset could be exchanged and a liability settled under an arm's-length transaction between willing, informed, and non-affiliated parties. (Article 28 section 6 of the Accounting Act).

In the light of the above definition, it may be discerned that the term "fair value" is even broader than the "arm's length value". The term "arm's length value" refers to a market method of valuation and is related to the price that is possible to be obtained on the so-called "active market". The active market is, in turn, defined in Article 8 of IAS 38 as a market in which all three of the following conditions are satisfied:

- the items traded in the market are homogeneous (uniform),
- the market is liquid (i.e. there are willing buyers and sellers),
- prices are known to the general public.

The existence of an active market is of importance when selecting the method of approach to valuation. The lack of an active market prevents the application of valuation methods based on a market (comparative) approach, as there are no transactions that could serve as a reference for the subject of valuation. Nonetheless, fair value can be determined even if there is no active market for the subject of valuation. In such a case, another valuation method should be applied, for example: income-based or cost-based. As mentioned earlier, each of the methods (especially, when there is no available data on comparable transactions) contains a certain amount of subjectivism. At the same time, each of the methods has ways of objectification of the process somehow embedded in them, which makes the calculated result more credible. The application of methods based on an approach other than the market one shall be effectively aimed at determining the value that is as close to an objective value as possible, and thus the one that could be recognised as obtained under an arm's length transaction between informed and non-affiliated parties.

The purpose of estimation is to determine a price that is as close to a market price as possible. The application of valuation methods included in the provisions of the Regulation of the Minister of Finance has a tax objective. In this way an amount of income generated by transactions between affiliated entities is determined for the purposes of taxation. Pursuant to Article 1 of the Regulation of the Minister of Finance, as a result of applying methods provided for in the Regulation, there should be disclosed an amount of income that may be reasonably assigned to affiliated entities as the outcome of transactions effected between them. Thus, these methods lead, in fact, to the determination of the fair value of the subject of transaction.

Due to obvious reasons, the provisions of the Regulation of the Minister of Finance are not applied in the case of transactions in which a price or a manner of determining the price of the subject of such a transaction is provided in acts of law and normative acts issued on their basis.

The basis for estimating income by applying all methods provided for in the Regulation is comparison. Conducting a reliable comparison requires the comparison of a reviewed transaction with a transaction that has analogous parameters and which has been concluded on an arm's length basis between entities operating in an analogous business situation. Therefore, in order to recognise that specific transactions are comparable, the analogy must occur at several levels, i.e.:

1. subjective level – which means analogy (comparability) of entities participating in a transaction,
2. objective level – which means analogy (comparability) of:
   - terms and conditions of a transaction,
   - subject of the transaction itself, *sensu stricto*.

Methods applied in estimating the value of intangible assets may include a comparable uncontrolled price method, a resale price method, a reasonable margin ("cost plus") method and a transactional profit method.

However, at this point it should be noted that business practice has worked out valuation methods that comprise: a comparable (market) approach, an income approach, a cost approach, an approach based on real options and an approach of advance assignment of value including methods by weights, lump sum, and reputation division. In principle, practical classification has a solid relation with levels of valuation carried out with the use of fair value, as provided for in IFRS 13 Fair Value Measurement.

4. Attempted estimation of the value of brand in affiliated entities

An empirical part of research is based on a capital group existing in the economic turnover. Due to confidentiality issues, the names of the companies have been changed. The BŁYSK sp. z o. o. company whose business activities include building car washes, selling washing equipment, and maintaining and repairing car washes is considering selling its brand name "BŁYSK" [SHINE] and "XYZ" brand, and the trademark protective rights that protect those brands to its affiliated company, ZENGA sp. z o. o., because of the planned restructuring. The "BŁYSK" brand is a corporate brand identical to the company's business name, and moreover, it is a brand that is quite well recognised in southern Poland and has been present on the market for over 5 years. The "XYZ" brand, on the other hand, is a brand that is about to be launched on the market, and the trademark is at the stage of application process in the Patent Office of the Republic of Poland and has not been awarded the right under its registration.

In the situation reviewed in the paper, "BŁYSK" and ZENGA are faced with two problems. Firstly, the companies are unable to determine the selling price of the brand (trademarks), knowing only that the value exceeds EUR 30,000. Therefore, it is necessary to determine the fair value of the trademarks that are to be sold. Secondly, the companies must prepare tax documentation and, with regards to this, they are obliged to define therein what method they have applied to estimate the market price of the trademarks.

In the situation under review, the entity that has been commissioned with the valuation to determine the fair value or to solve problem 'A' has used two calculation approaches, namely the cost-based and income-based approach. In the cost-based approach the value of a given brand would be equivalent to the expenditures incurred for it. Thus, the application of the cost method has cumulated costs for "BŁYSK": preparation of the artwork for the trademarks (PLN 20,000), registration costs of 10 trademarks (PLN 50,000), and expenditures incurred for the advertising and marketing of trademarks (PLN 229,000). The application of such procedure has produced an amount of PLN 299,000.

For the XYZ company the result obtained under the cost method has amounted to PLN 7,000, which is made up of: the cost of developing 1 trademark (PLN 2,000) and the cost of registering 1 trade mark in the Patent Office of the Republic of Poland (PLN 5,000). It has been assumed that, because of considerations applicable in the case of cost-based approach, the above value shown in the table for the "BŁYSK" brand shall constitute the lower threshold value for this brand and

the lower threshold for all trademarks protecting this brand. For the "XYZ" brand, it has been assumed that the calculated value is the fair value that may be recognised as a market price.

Next, the value of the "BŁYSK" brand has been calculated by applying the income-based approach, and, to be precise, the method of avoided license fees. The valuation method based on market license fees consists in determining the present value of future benefits that are derived from having a brand protected by rights to trademark or trademarks. In order to calculate the net income from the license, the license fees should be reduced by a hypothetical value of income tax according to the following formula:

- licence fees* (1 – income tax rate),
- calculation of the discount rate, taking into account the risk characteristic for the trademark/brand that is subject to valuation,
- discounting licence payments after taxation during the projection period and calculation of the residual value.

The sum of discounted licence payments and residual value makes up the value of the trademark that is subject to valuation. The results of calculations are presented in Table 2.

Description of Table 2:

1. **Item 1[Net income]** – the prognostic sales plan is given. Data derived from the company's management board.
2. **Item 1a [Growth rate]** – the values has been calculated on the basis of position 1 [net income]. Growth rate is the growth rate is the percentage change between the expected income in subsequent consecutive years of the sales plan.
3. **Item 2 [License fee (Royalty rate)] –** the royalty rate has been selected from commercial databases e.g. RoyaltySource[2]. The royalty rate should correspond to the rates used in comparable market transactions.
4. **Item 3 [CIT] –** is derived from country legislation.
5. **Item 4 [cashflow generated by the tm]** – the difference resulting from subtracting avoided royalties, net of income tax due (Item 2 – item 3).
6. **Item 5 [Discount rate] –** The calculation of the discount rate takes into account the risk factor, the cost of capital for Trademark used to discount the due royalties, net of income tax was calculated on the basis of the cost of capital (WACC).

Table 2. Valuation of the "BŁYSK" trademark by income method

No.	Input data (assumptions)	value of rates	HISTORICAL DATA in millions of PLN						FORECAST						Residual period
	Theoretical period								1	2	3	4	5	6	
	calendar years		2008	2009	2010	2011	2012	2013	3 months 2014	2015	2016	2017	2018	2019	
1	Net income from sales		9.5	12.9	10.3	16.9	11.6	5	5.3m	5.6m	5.8m	6.1m	6.5m	6.8m	7.1m
1a	growth rate (%)			35.76	-19.81	63.82	-31.20	-56.34	5.00	5.00	5.00	5.00	5.00	5.00	5.00
2	License fee (% of item 1)	2%							106,995	112,345	117,962	123,860	130,053	136,556	140,000
3	Corporate Income Tax (CIT) (% of item 2)	19%							20,329	21,345	22,413	23,533	24,710	25,946	27,000
4	Flows generated by the Trademark after taxation (item 2-item3)								86,666	90,999	95,549	100,326	105,343	110,610	116,000
5	Discount rate	25%													
6	Discounting factor								0.9999	0.64	0.51	0.41	0.33	0.26	
7	Discounted flows (present value of cash flows) [It. 4 x It. 6]								86,657	58,239	48,921	41,094	34,519	28,996	

Source: own compilation.

The weighted cost of capital was calculated based on the capital asset pricing model (ang. Capital Asset Pricing Model) modified to take account of the risks associated with the trademark, according to the following formula:

$$Ke = Rr + Rp\ \beta i\ x + A + B \quad (1)$$

where:

Rr – risk free rate adopted at the level of the average yields of 2-year and 3-year treasury bonds offered in the first quarter of 2014. Risk-free rate at 30 September 2014. amounted to approx. 4%,

Rp – market risk premium, which is the average rate of return over the risk free rate required by the shareholders in the long-term investment horizon. Market premium is, as a principle, the difference between the rate of return on investment in companies shares and the return on investment in a decade treasury bonds. In this valuation premium for market risk assumed at 7%[3] (),

βi – corrected leveraged beta factor for the industry measure of systematic risk borne by the owners of capital. This factor takes into account operational risk and financial risk of the company. The beta ratio measures the ratio of variation rate of return on assets at a given relation to the volatility of the market rate of return (represented by the selected stock index). Bearing in mind that the company is not listed on the stock exchange for the purposes of valuation adopted leveraged beta value of 1,

A – bonus for low capitalization reflects a higher rate of return, which is usually achieved on investments in companies with lower capitalization. Adopted a bonus of 0% due to the fact of being a company over the counter and the lack of stock quotes,

B – specific risk premium, reflecting, among others, risks associated with the implementation of the financial forecasts, was adopted in a subjective manner at the level of 14% taking into account the risk premium specific to reputable companies listed on the Warsaw Stock Exchange at the level of approx. 2.5%.

Therefore: Cost of capital [Discount rate] = 4 + 7x1 + 0 + 14 = 25%

7. **Item 6 [Discounting factor]** – was calculated It was calculated by the following formula:

$$\text{Discounting factor} = 1/(1+\text{discount rate})^{n\ \text{(theoretical period)}} \quad (2)$$

Residual value calculation for the "BŁYSK" brand is presented in Table 3.

[3] See: Country Default Spreads and Risk Premiums [as of January 2012] Aswath Damodaran http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ctryprem .html; Tomasz Wisniewski, "How to measure the risk of investing in shares?" article.

Table 3. Residual value calculation for the "BŁYSK" brand

Residual value calculation	
Normalised cash flows rounded up	116,000
Growth rate in the residual period	5%
Discount rate	25%
Residual value	609,000
Sum of present value of cash flows during the projection period	300,000
Discounted residual value	188,700
Brand's Value (without a tax shield)	**PLN 488,700**

Source: own compilation.

As a result of applying the income-based approach, it has been determined that the value of the "BŁYSK" brand is PLN 488,700, which, in comparison to the cost value of PLN 299,000, gives a relatively large deviation. At the same time, due to the significant uncertainty about the company's financial forecast caused by the change of supplier of washing equipment, it has been acknowledged that, given the circumstances, both methods are equivalent, assuming that the cost-based approach determines the minimum value of the brand and the income-based approach determines the brand's maximum value. As both approaches have been assigned the same weight, it has been determined that the fair value is the closest to the arithmetic average obtained from both of the generated results, thus the fair value is: PLN 299,000 + PLN 488,700 = PLN 787,700 : 2 = PLN 393,850, while the value of the "XYZ" brand is manifested by one protective right from the registration of the trade mark, so the value should be set at PLN 7,000.

In conclusion, the solution to problem 'A' is the result of the valuation of both brands: (i) "Błysk" – PLN 393,850; (ii) "XYZ" – PLN 7,000. The solution to problem 'B' is the indication of the reasonable margin ("cost plus") method.

5. Conclusion

The primary purpose of the valuation of intangible assets is to determine their fair value, which is understood as the amount for which an asset could be exchanged and a liability settled under an arm's-length transaction between willing, informed, and non-affiliated parties. Simultaneously, it must be remembered that transactions whose subjects are intangible assets should remain within the sphere of interests of tax law and tax authorities. Particularly problematic are transactions concerning intangible assets between affiliated entities. Thus, a question arises concerning what intangible asset valuation method should be selected to avoid tax risks. A typical situation occurring in practice is a situation when the group is subject to restructuring and the rights to intellectual property are transferred onto a subsidiary company that acts as an administrator of intellectual property rights. Nonetheless, undertaking such actions requires that the fair value of tangible goods is determined, for example, with regard to patents, trademarks or industrial designs, that are to make up the subject of assignment (transfer). At the same time, due to tax considerations, it is necessary to determine the market value, taking into account the methods provided for in the Regulation of the Minister of Finance.

Based on the reflections presented in this paper, it seems that, to some extent, tax methods overlap the valuation of intangible assets in the accounting system. It must also be noted that essentially

each of the tax methods and approaches used in practice is based on comparing or benchmarking to similar historical transactions. The above premise is not applicable to the cost-based approach and approach based on real options only.

As regards its methodology, the comparable uncontrolled price method comes closest to the comparable approach. However, pursuant to this method, there are also ways of valuating intangible assets that are based on the income-based approach. In such a valuation, coefficients are used, for example, the amount of the license fees, that are derived from comparable transactions known on a given market or industry.

Due to it being based on a gross margin account, the resale price method is closest to valuation using the cost-based approach under which the recreation or replacement cost of an intangible asset is first ascertained, which can then be increased by any benefit corresponding to the margin.

Likewise, the reasonable margin ("cost plus") method contains the cost-based approached enriched by the calculation regarding the cost base of the profit mark-up. In its definition, the transactional profit method, in turn, completely exhausts the assumptions on which valuation made according to the income-based approach depend. In both cases, the potential benefits that an asset to be sold may bring in in the future are examined, discounting future cash flows with the use of properly selected coefficients.

Nonetheless, irrespective of the selected valuation method, it must be remembered that the safety of the prepared estimation of fair value (transactional price) is not so much decided by the method itself, but rather by the ability of reliable and logical justification of applied coefficients.

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Chapter 19

Contemporary Accounting and Management

Mirosława Kwiecień

1. Introduction

The cause for undertaking research into contemporary accounting is a book by Thomas Piketty, *Capital in the Twenty-First Century* (2014), in which T. Piketty describes a problem of an uneven distribution of wealth and progressing income inequalities in developed countries. A question arises, especially among the economists (not accountants), what is a link of complicated economic issues (about inequality of incomes) with accounting? For accounting, the same as economics, is a social science, i.e. a science which should watch what is going on also at the point of contact between business operations and natural environment, at the point of contact between technology and culture of operation of an economic organisation, at the point of contact between politics (political risk) and global economy (financial crises, etc.) (Kołodko, 2014, pp. 281-285). Hence problems that are a challenge to contemporary economy are also a challenge to contemporary accounting, manifesting itself in a tendency to orient the development of accounting for the purposes of accountability of corporate social responsibility, i.e. changing aspects of globalisation meaning the need to combine a principle of individual managing efficiency with moral principles determining social and ecological aspects of business operations.

A business model adopted by managers of an economic organisation – conditions adopting qualifying criteria agreed by them, e.g. economic events, especially a valuation method of particular financial resources and capitals as well as a method of disclosing and presenting in reports. On the basis of research into source literature and also empirical studies (a consolidated interim report of 1st quarter of 2015 as well as 1st quarter of 2016 of a Polish group of companies of the primary sector, listed on the Warsaw stock exchange). It is necessary to agree with the statement by, among others, G.K. Świderska and others that valuation of e.g. stores of both raw materials, and products manufactured depends on an adopted business model. It is a result of the fact that this method should take into account the likelihood of implementation of profits on the sale of them regardless of in which reporting period the actual implementation of these profits will take place. Similarly the valuation of obligations, and reserves built up on different bases is conditioned by a business model adopted by managers of an economic organisation, which, in turn, is a result of the fact that the valuation of obligations and reserves of an economic organisation depends on the date of implementation of obligations, and also on the likelihood of "giving rise to" costs for which the economic organisation builds up the reserves. Accuracy of the statement by G. K Świderska and

others is confirmed by economic practice that a business model adopted by managers of an economic organisation determines the manner of aggregation and disaggregation of reporting information (e.g. information concerning segments of operations, financial results of reporting segments, fixed assets – geographical breakdown, etc.). A business model determines a hierarchy of importance of information **disclosed in reports** (Świderska et al., 2014). It is not a revealing idea, but worth being reminded of that accounting (as a system) is a reflection of structures entangled (situationally conditioned) by economic, social and cultural neighbourhood as well as natural environment. The essence of this reflection is the measurement of creation, transfer and division of value.

An increasing demand for financial and non-financial information from different entities interested in operations of a given economic organisation, especially from persons managing, and also owners of capital caused **asymmetry of information**. It is the fact that one of the reasons for this was and is progressing globalisation and complexity and obscurity of economic links connected with it. Hence many international organisations, among others, International Integrated Reporting Council (IIRC), Association of Chartered Certified Accountants (ACCA), etc., and, above all, the European Union are faced with a challenge of capabilities of establishing and enforcing as well as tendencies to establish and enforce an economic order. A model for European solutions in disclosing and presenting good practices with regard to the economic order was the Sorbanes-Oxley Act. Its essence has been counteracting crime and corruption. For an increase in the value of an economic organisation should result from its objectives – from a business model which should be published in annual reports. It should be an integrated report.

Contemporary accounting is integrated accounting whose final product should be an integrated report. The essence of this report is effectiveness of communication, relevance of information in creating an added value by an economic organisation, and also building stakeholders' trust. Understanding a business model of an economic organisation is, among others, understanding in which external and internal conditions and "on which" the economic organisation makes profit. Hence an analysis of financial information in the context of a business model is enriching qualitative features of reporting information, which determines its usefulness, especially in the context of corporate social responsibility.

In this publication, the Author made an attempt to indicate new interdisciplinary research problems both for accounting, and management – in the context of an integrated report. The purpose of the article is to indicate (using methods of cognitive action: deduction, induction, based on source literature – accounting and management, and also empirical studies) main areas of changes in reporting of an economic organisation determined by the model of management different for each organisation.

2. Business Model and Integrated Report

On the basis of source literature (Osterwalder & Pigneur, 2012; Page, 2014; Duszkowska-Piasecka, 2012; Świderska et al., 2014; Karwowski, 2015; Krasodomska, 2015 and others), a guess can be hazarded that there is no one universal definition of a business model. Most often in the source literature of both accounting, and management, a business model is most often understood as a model that "describes premises which are behind a way in which an organisation creates value as well as ensures and derives gains from the generated value" (Osterwalder & Pigneur, 2012, p. 18). According to these Authors, a business model consists of many elements: e.g. geographic segments – of strategic assets, segments of operations, etc.) – in more detail (see: Karwowski, 2015, p. 257). Special attention should be paid to research by T. Falencikowski (2013)

with regard to the definition and typology of a business model, it results, among others, from the fact that he distinguished sixty-six (66) definitions of a business model. It is my conviction that the definition of a business model formulated by T. Falencikowski is essential for systematics (the typology of a business model) as well as for description of its individual elements – "a business model is a relatively isolated compound conceptual structure, describing carrying on business by articulating the logic of creating value for a customer and of intercepting a part of the value for an enterprise" (Falencikowski, 2013, p. 17).

The model of Anglo-Saxon accounting reflects modern concepts of management because increase in the value of an economic organisation, i.e. in net assets is its main objective of operations. Both internal, and external conditions (environmental, social ones, etc.) which fall into the concept of corporate social responsibility (CSR) have strong effect on business operations, but these aspects are not disclosed in financial statements (in more detail: Cieślak, 2011; Garstecki, 2015; Kwiecień, 2015a; Kwiecień, 2015b; Kwiecień, 2011; Kwiecień, 2010; Kwiecień, 2013a; Kwiecień, 2013b; Sobańska & Michalak, 2009; Sobańska, 2012; Świderska et al., 2014). While, the model of continental accounting reflects conservative and eclectic principles of management – according to which intangible assets (e.g. assets regarding competence, etc.) do not from the value of an economic organisation. The model of continental accounting – is disclosing and presenting a book profit as a result of (purchase and sale) transaction (in more detail: Kwiecień, 2015a; Smejda, 2015 and others). The model of Anglo-Saxon accounting, and in fact international regulations (as an effect of harmonisation and standardisation of accounting), is applied by public interest companies. These regulations facilitate "a higher degree of global order in the modern world – capital markets" (Hendriksen & van Breda, 2002, pp. 280-359). The essence of both accounting models is the concept of keeping capital (in more detail: Smejda, 2015) – the concept of profit. For accounting profit (the continental model) was based and in some respects is still based on such concepts as the implementation of revenue and the proportionality of costs of revenue. Hence it is assumed that both basic areas of operations of an economic organisation, and "overall operations" can be the subject matter of measurements (historical cost) and reports (financial reporting) (in more detail: Hendriksen & van Breda, 2002, pp. 321-359). Nonetheless, the long-term objective of each concept of profit is its link with actual observations – because from the widely understood economic and social point of view, the whole profit generated by an economic organisation (tangible and intangible resources) should be treated as an economic profit (in more detail see: Hendriksen & van Breda, 2002, pp. 354-359; Smejda, 2015 and others). It is necessary to agree with the statement by D. Dobia, A. Rosolińska (2012, p. 251) that "practice shows, however, that so conservative approach to which can be disclosed as a company resource causes considerable differences between reported values from an accounting system, and how the company is priced by persons managing or by the market. Market participants, in order to make wise decisions, should be informed about intangible resources of a company because this is these resources that to a large extent determine whether or not the company will be successful on the market".

It should be highlighted that an objective of operations of each economic organisation is to earn a competitive advantage, i.e. increase in customers satisfaction, but in order to increase customer satisfaction, an economic organisation must be able to summon up knowledge, technology as well as experience and offering new (products and services) or innovative methods with the use of which they create them and reach customers with their offers. An economic organisation must learn to continue innovation. One of the key problems in innovation management is the need to "reach" the essence of many complicated, risky occurrences changeable to a high degree – hence the need arises

to "construct" business models describing functioning of business and a way how a given economic organisation will be implementing profit. **Will profit** be **a means of maximisation of shareholders' wealth** (the concept of keeping wealth – change in capitalised value of anticipated cash receipts) or will **profit** be **a meter of management efficiency**. **Management efficiency** – understood as an optimal use of **limited resources**. In this case profit becomes a means for implementation of a valuable objective – being, among others, corporate social responsibility (in more detail see: Pearce et al., 2011, pp. 48-148; Tidd & Bessant, 2011, pp. 147-301; Senge, 2006 and others). Corporate social responsibility – it is an effect of a financial crisis, fraudulent financial reporting. Owing to operations of IIRC, ACCA, and of the European Union – a new concept of integrated reporting came into existence which assumes publishing by a company a report presenting financial and non-financial information concerning strategy, results of operations as well as management along with commentary relating to market and social environment in which it operates. This information is disclosed in a way indicating mutual relations between the issues discussed… A business model as well as resources and relations which a unit uses and which it shapes, called capitals, have special importance in the concept of integrated reporting (Krasodomska, 2015, p. 79). It is necessary to agree with the statement by E. Burzym (2008, p. 82) (and it results from the fact that functions of accounting have evolved) that "accounting is more and more becoming social welfare owing to socialisation of inspection and evaluation as well as owing to use (to a more and more wider extent) of compulsory accountability of companies and institutions for widely understood social and economic rationality of use of tangible and human resources. As it appears from the above statement (which was and is proved by economic practice), business operations of economic organisations is dependent on different forms of capital which should be taken into consideration in their business models and adopted strategies. According to J. Krasodomska, six concepts of capital can be distinguished:

Table 1. Description of Six Capitals

Capital	Description
Financial Capital	It includes capital obtained owing to indebtedness (loans) or owing to carrying out operations and investment.
Manufacturing Capital	It includes buildings, facilities and machines as well as infrastructure (bridges, sewage-treatment plants).
Intellectual Capital	It relates to intellectual property, such as patents, copyright, software, licences as well as to organisational capital understood as knowledge of an organisation, systems, procedures, policies and intangible resources connected with the brand and reputation.
Human Capital	It concerns employees' competences, experience and motivation for development and innovation, including: • obeying the principles of corporate governance, risk management, ethical values, • abilities to understand, develop and implement the strategy of the organisation, • motivation for improvement and development of processes, products and services, including employees' skills with regard to leadership, management and cooperation.
Social and Relational Capital	It concerns standards, values and behaviour applied in an enterprise as well as relations with external stakeholders, such as customers, suppliers, business partners, local communities.
Natural Capital	It includes all renewable and non-renewable resources and processes owing to which products or services such as air, water, soil, minerals and forests, ecosystems, emissions, sewage, waste are delivered.

Source: (Krasodomska, 2015, p. 81).

3. Conclusion

Integrated reporting is a challenge to contemporary accounting and to contemporary management – as an applied social science. Both accounting, and management are a science because of their methodology, and an applied science because of their goal-orientation, which is corporate social responsibility, which determines undertaking interdisciplinary research with regard to presentation of a business model in integrated reporting, which requires changes in the mentality of both persons managing, and accountants. Synthesis of empirical studies (consolidated interim financial statements of polish capital group of extractive industry, listed on the Warsaw Stock Exchange since 1996) entitles to the above statement or starting interdisciplinary research in the development of the concept of disclosure and presentation of **the business model** in an integrated report. The audited capital group (72 public interest companies) is one of the 14 groups in Poland, which prepared their a report on corporate social responsibility (CRS), which is revealed and presented beyond consolidated financial statement. A corporate social responsibility report is in my opinion the answer to the social inquiry – to what extent the economic organization "supports" the local community. On the basis of CSR report (for 2012-2014), one can venture to say that the audited capital group revealed therein the indicators of environmental activity area. Reporting on Business Social Responsibility (often referred as corporate social responsibility – more widely Kostera & Śliwa, 2010; Kwiecień, 2010, 2011 and others) is **voluntary**. In the literature of management (Koster & Śliwa, 2010 and others), there are many definitions of corporate social responsibility (one of them is the definition of the European Commission – 2009) – corporate social responsibility is a concept referring to the voluntary integration of the company's social and environmental issues, in their business operations and the interactions with stakeholders (more widely: Koster & Śliwa, 2010, pp. 40-47). The results of research in the field of reporting on corporate social responsibility in polish economic practice is not the only answer to **social pressure** and, therefore, this report refers to the activity for the local community. In the literature of management. corporate social responsibility report is the implementation of the principle of "the enlightened egoism", according to which, economic organizations "strive to generate a results beneficial for society, which will also lead to generating positive results for themselves" (Koster & Śliwa, 2010, p. 46). Report on corporate responsibility (KOS or CSR) does not fulfill the expectations of many economists, who believe that the economy of moderation is the future of economic development (Kolodko, 2014; Piketty, 2014 and others).

Integrated report is a challenge for modern management and accounting, is a return to research on the concept of capital preservation. "Capital... is a some resource, to which the organization has access to and which organization uses. Information about capitals is an important element of presenting how the unit create value. The activities of enterprises depends on the different forms of capital, which should be taken into account in business models" (Krasodomska, 2015, p. 80). One must agree with the statement of J. Krasodomska, that the concept of the six capitals (as above) and their recognition in the business model – is a challenge for a method of assessing the corporation effectiveness (Krasodomska, 2013; Świtała, 2013). Key performance indicators used to quantify the achievements of public interest companies, although are tools to quantify the achievements of economic organization (listed companies) in the of financial, social and environmental areas, but in these last two areas – lack of standardization of indicators – lack of links with the business model (Krasodomska).

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Chapter 20

Ethics in Auditing

Lesya Ratushna

1. Introduction

Ethics is usually associated with the teachings of philosophy, not mathematics, finance or accounting. However, for many years the development of enterprises and entrepreneurship ethics gained importance in business and finance. It was noted that the observance of ethical standards has a positive effect on the quality of the formation of financial statements and the results of subsequent financial reviews. Ethics is very important in finance also because each auditor to a code of professional ethics and act as "guardian of quality". At present rate of economic growth it is very high. Today appreciates the speed and quality of the data provided and information and therefore ethics is what builds trust, that you do not need extra check any information. Much is written about this in the scientific literature, lead discussions, not only in scientific circles but also among ordinary citizens. Interest in this kind of problem confirms the timeliness of, or the application of ethics in financial activities is one of the factors, which help to achieve long-term development of the enterprise.

The purpose of this article is to draw attention to the essence of ethical behavior in the financial audit. Due to the fact that this subject can cover a wide range of analysis in this paper we focus on presenting classic examples of unethical behavior in auditing. Often speaking about ethics comes up to this subject was from the other side – that really describes unethical behavior. In the literature often appears on ethics in finance or ethics in accounting. Recognition of ethics in auditing is a concept narrower and less as described in the literature. For this study sought to select primarily the literature primarily concerning ethics in the area concerning auditing, and not widely in accounting, finance, etc. Postulates of being ethical says most of the participants in economic life, but whether we are able be ethical every day at work – this question will let the attached answer in cases of hardship, and corresponding with the theme of the work test – Is the work aiming for ethics.

2. Ethics – the beginnings of professional ethics

For further delving into the topic of ethics, we must first give the definitions of ethics and define an area of interest in this science. T. Ślipko SJ (2002, p. 21) in his book "The outline of general ethics" offers the following definitions to define the term ethics: "Ethics is a philosophical doctrine,

which lays down the general principles and specific moral norms of human action with the innate human cognitive abilities". In other words, it is a normative philosophical discipline, the aim of which is the justification or subjected to moral evaluation of various principles of law, morality colloquial state institutions or activities of people or groups.

The father of ethics is considered the Greek philosopher Socrates (Najder-Stefaniak, 2006, pp. 5-6). It was he who in their deliberations discoursed on how best to live, showing the way of the future development of ethics (Kwapiszewski, 2001, pp. 7-8). The ethical Principles of Socrates, the read in the writings of other philosophers. Socrates did not leave behind any written work. The first rule of ethics of Socrates – virtue. As a second – I've included a combination of Virtues and knowledge, otherwise ethical intellectualism. Socrates quotes that any unethical conduct arising from lack of knowledge and of the unconscious about what the human good and what is bad.

We live in the era of formation and development of free market relations in the era of globalization. At a time when not only become blurred boundaries between countries, but also become blurred boundary in matters of ethics. In other words, the cooperation of different continents with different cultures requires the establishment of ethical standards in various fields which will allow for easier cooperation and reduce the number of situations of conflict. In addition, by this time known to us, medical ethics, educational, legal, diplomatic, military every year louder talking about myself ethics administration, sports, and in recent years we often hear about ethics in finance, ethics in auditing. More and more often we hear examples of no ethical proceedings of auditors. One of these, at the present day classic textbook examples of the company Enron and the company conducting audit checks Arthur Andersen. About this the forfeiture will say author later in the article.

More and more often we are unaware of the fact that the progressive development of modern society depends very much from the professional level of the employee, his culture, moral – ethical. Professional activity, the main object of which there are living people, creates a complex system of moral – ethical connections.

For such a system we can include:

- the ratio of specialist to the subject of work (doctor – patient, teacher – student),
- the ratio of specialist to colleagues at work,
- the ratio of specialist to society.

This kind of relationship examines professional ethics. According to W. Drzeżdżon (2013, p. 22): "Professional ethics is the philosophical doctrine of man's moral improvements needed to make your favorite work. You have to like your profession, eager to do what is best and also know how. In other words, ethics is a theory responsible, and therefore morally well-executed operation, performed by the skills or habits conditioning work effectively".

Professional ethics is a set of rules and standards that protect workers against abuses in working life on the part of employers. Ethics also protects employers from unfair behavior of employees. Determines courses of action that are consistent with social expectations.

Professional ethics can be classified into types of descriptive ethics. Because it is descriptive ethics in the selection of the specific action it is good or bad for a particular social group, and retaining this character only in a particular social group (Borowski, 1996, pp. 8-11).

The father of professional ethics can be called Hippocrates, because it was he who formulated the rules for the medical profession, and thus created a pattern of professional ethics. A significant difference between the general and professional ethics is that ethics in general more difficult to

formulate rules of conduct in specific occupations. On the other hand, professional ethics gives a possibility. It is more precise than for the general ethics (Porębski, 1997, pp. 140-141).

In the twenty-first century, much has changed approach to ethical principles are increasingly entering the business. You do not think that the "goal of the game is to profit from the shares and there is no other game". With the development of global market information each company has a take care of their ethical image. Otherwise, mistakes and no ethical behavior of staff at one end of the globe, will be reflected immediately echoed in other parts, causing financial loss and customer confidence. A further loss and positionally in the market (Minus, 1998, pp. 16-23).

Professional ethics is primarily a specific code of ethics. Every profession requires people working in the observance of certain moral norms. Some of professions that do not require significant changes in accounting standards, rules of human behavior, and others constantly requires. According to the author of the paper type of activity in which man and finance is the subject of influence, as most in need of attention from professional ethics.

3. The place of ethics in auditing

Financial audit, is nothing but the analysis, the study of historical financial data. Often in the literature you can meet another term for this kind of phenomenon, in other words financial audit. The term audit comes from English and means revising the books, accounts report. There is one element of which fall within the scope of accounting (Praff, 2011, pp. 10-13).

For further analysis of the article topic, you must define who is an auditor and what role to play in auditing. On the Regional Branch of the National Chamber of Statutory Auditors in Warsaw stated that: "The auditor is a person of public trust, whose work consists of verifying and confirming that the financial information flowing on the market from companies and organizations are true. This applies, of course, selected units, whose financial statements under the law are subject to verification auditor" (*Kim jest biegły rewident?*). The regulations provided meet the Act of 7 May 2009 on auditors and their self-government.

When preparing financial statements, the most common mistake lies in the recognition of revenue. The auditor has the task during the audit of the financial statements indicate the person responsible for this kind of work, which may or may not hide mistakes. As financial report aims to faithfully reflect the financial position and financial performance of the audited company. It must be up to you adapted to the needs of the readers of this report. As readers may be a potential lender, investor, various creditors. Properly prepared a report for them is the point of reference in taking decisions related to the ability to generate future returns (Sajewicz, 2014, p. 89).

For generalization of the principles to be followed every auditor of 13 June 2011, the National Council of Statutory Auditors decided that the Code of Ethics for Professional Accountants of the International Federation of Accountants (IFAC) will be the basis of professional ethics of auditors. This resolution was approved by 20 July 2011, by the Commission of Supervision of the Audit and began to operate from 1 January 2012 (Burnos & Kryśkiewicz-Burnos, 2013, pp. 94-95). In accordance with the fundamental principles described in the Code of Ethics IFAC the auditor is to observe the following rules (Burnos & Kryśkiewicz-Burnos, 2013, pp. 102-103):

- Integrity – act fairly by all the services concerned,
- Objectivity – no pressures and conflicts of interest cannot influence the decisions of the auditor,
- Professional competence – the auditor is required to have and maintain the expertise,

- Confidentiality of information – confidentiality of the information obtained during the audit to a third party,
- Handling professional activities carried out by the auditor must comply with the law.

As I noted above, the audit profession, the profession of public trust. In other words, the auditor work not only for the individual customer, but also on the social responsibility of pregnancy and it is for this must comply with all the above-mentioned principles.

Non-compliance with the ethical principles described can lead to terrible consequences such as bankruptcy. An example of unreliable work and failure to comply with professional ethics as an example can be given earlier mentioned audit company Arthur Andersen provides services for the company in the energy industry, Enron.

Enron Corporation – former American energy company based in Houston, Texas. At the end of 2001, the company declared bankruptcy, after a scandal falsification of financial records of the company. Before the announcement of the bankruptcy of Enron employed around 22 000 employees and was one of the leading world companies in the energy industry (*Enron – spektakularny upadek giganta branży energetycznej...*).

It is the lack of integrity of the statutory auditors caused this that in the years 1997-2000 in the financial statements approved by the company's auditors, Arthur Andersen was given overestimated the profit generated by Enron (*Afery finansowe...*). By controlling the current activities of the auditors could not point out mistakes and imperfections in the audit interim financial statements because it would mean that they hid the information in the current audit. Reluctance to admit error led to the bankruptcy of Enron and Arthur Anderson firm to a loss of trust among customers. After the financial scandal, Enron became the symbol of intentional fraud and corruption in corporations.

4. Conclusion

Such values as democracy, freedom, justice and development are not given once and for all. For their consolidation and development we are needed: collaboration, knowledge. For the development of trade and business in general, you need not only a good product, but also a social investor confidence in the manufacturer. And it is ethical behavior among employees is the best way to meet this kind of rules (Kietliński, Reyes & Oleksyn, 2005, p. 278). You have also noted that finance is the river after which the flow of goods (Gasparski, 2004, p. 44). Ethics in financial activities, especially in the revision I perform the sign, showing the boundaries that must not be exceeded, otherwise the ship company will go to the bottom. In other words, ethics in finance increases the Transaction of financial security, as air is to fire. Without ethics in finance and auditing would be no possible development of a market economy at the global level, as each transaction in addition to the signed agreement is also based on trust.

In conclusion I suggest you solve a short test to check how each of us is ethical in their work.

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Appendix – Test – Is the work aiming for ethics?[1]

Read all instructions carefully and select the option that best describes you.

1. You just printed a 200-page document that used all the paper in the printer.
   A. You refill the paper tray immediately.
   B. You casually mention that the machine's out of paper to people around you so they know to refill it before they hit print.
   C. Eh, they'll figure it out eventually.
2. Your boss hands you a stack of papers that accidentally includes confidential personnel files.
   A. Immediately return the files to the boss once you recognize the mistake.
   B. Search through the pages just to find your own file.
   C. Read everyone's files.

[1] Author of the test is Anthony Balderrama CareerBuilder.com.

3. You're running late because you got a little too happy at last night's happy hour.
   A. You call ahead to warn your team you'll be late so they're not further inconvenienced by your tardiness.
   B. You show up late and hope no one notices.
   C. You show up late and blame a horrible (imaginary) car wreck that caused traffic to back up for miles.
4. You haven't had a vacation day in months and realize you'd like to take tomorrow off.
   A. Tell your boss you need to use a vacation day to unwind and recharge.
   B. Start coughing and mention you feel bad so that you've built a convincing reason to call in sick.
   C. Wait until the morning when you know the boss hasn't arrived. Leave a message saying an emergency's come up and you can't make it in today.
5. In the middle of the most boring business meeting, you realize you could be more productive (or less bored) if you were at your desk instead.
   A. Grin and bear it because it would be rude to leave.
   B. Pretend to have received an urgent call or e-mail and go back to your desk to work.
   C. Pretend to visit the restroom but go back to your desk and update your Facebook.
6. You find out your cubicle neighbor is having a secret affair with the intern in accounting.
   A. You pretend you know nothing about it.
   B. You tell your closest work friends because you know they won't tell anyone.
   C. You tell anyone who will listen.
7. You just accepted a job offer at a new company. It begins in a month, so you're going to wait two weeks to give your notice. The next day the boss comes in and explains how he wants to restructure the department and your role is pivotal.
   A. To prevent his plans from going awry, you decide to tell him now that you're leaving in a month.
   B. You go along with his plans for now, but still give your two weeks' notice so that he receives ample warning time and you aren't let go a month before your new job starts.
   C. You wait until your last day to tell him that you're gone and it was nice knowing him.
8. You know the boss is in a terrible mood. You also know your co-worker is about to go ask the boss for a ridiculously large raise.
   A. You quietly warn your colleague that the boss is probably going to throw scissors at him if he goes in there today.
   B. You mind your own business because you don't want to get involved.
   C. You don't mention the boss' bad mood and instead get your colleague fired up and encourage him to triple the salary request.
9. It's 3 p.m. the day before Thanksgiving and everyone is on vacation. The phone hasn't rung once and no e-mails have come in.
   A. You stay at your desk until 5 p.m. because it's your job.
   B. You wait 30 more minutes to make sure nothing comes up, and then you leave.
   C. Ha! You've been gone since noon.
10. The boss loves the ideas you pitched to everyone and can't stop showering you with accolades. The problem is, the ideas were a joint effort between you and your colleague.
    A. You say, "Thanks, but I didn't work alone. Sheila worked just as hard as I did."

B. You take the praise, and eventually tell Sheila what happened and that you didn't know how to tell the boss.
C. You accept the accolades and try to get Sheila fired before she finds out you've stolen the spotlight.

If you scored:

All A's – You're the poster child for ethics.

We should all be as pure as you. As long as you're not gloating about your ethical infallibility, you serve as a great role model for those around you.

Mostly A's – You're not perfect, but you're still a role model.

No one's perfect, so you shouldn't feel too bad. Every now and then you stray, so just listen to the little voice that tells you to do the right thing most of the time a little more often.

Mostly B's – You've forgotten a few things your parents taught you.

You could do worse – much, much worse – but you still stray from the right decision now and then. Just think twice before you make a few decisions and you'll be good to go.

Mostly C's – You're far from perfect but could be worse.

OK, sometimes you teeter close the edge of unethical and might be damaging your career. You can still redeem yourself now and then. With a little hard work, you can probably perform some damage control and get on the right track.

All C's – You'd steal candy from a baby. And laugh about it.

Let's be honest, your reputation is probably not so great. In fact, people probably check their wallets once you've left to make sure nothing's stolen. Now's the time to decide if you want to start fresh with strong relationships and a better reputation.

PART IV

DEVELOPMENT OF MODERN INFORMATION AND COMMUNICATION TECHNOLOGIES TO SUPPORT DECISION MAKING

Chapter 21

Retrieving Product Ontologies by Textual Analysis of Consumer Opinions[1]

Paweł Wołoszyn, Katarzyna Wójcik, Łukasz Walewski

1. Introduction

Written consumer opinions provide an important source of feedback information useful in product design, quality management or marketing. However they can also be regarded as textual representation of specific ontology adopted by consumers who perceive goods and products as entities with parts and attributes bound with such relationships as aggregation, generalization or association. Although consumers do not describe their ontologies explicitly, it is possible to reconstruct them, at least partially, by analysing the grammar of written opinions. In this paper we present an example of such approach based on detecting occurrences of noun pairs in consumer opinions written in Polish language. Obtained ontologies can be further used for product comparison, classification and similar tasks.

2. Background

Consumer opinions are subject of sentiment analysis and opinion mining. In the literature phrases "sentiment analysis" and "opinion mining" are often used as synonyms. However the difference in its definitions and in the aim of each of them can be determined (Lula & Wójcik, 2015). Sentiment is defined by Pang et al. (2002) as overall opinion towards the subjects mater. So the sentiment analysis can be defined as actions aiming only to determine the attitude of speaker or writer to the subject of opinion (often this attitude is called a polarity). In the same time opinion mining is defined by Dave et al. (2003) as analysis processing a set of search results for a given item, generating a list of product attributes (quality, features, etc.) and aggregating opinion about them (poor, mixed, good). In the field of opinion mining there are three main areas (Liu, 2007):

- Sentiment classification – assignment of sentiment to whole opinion or division of opinions into groups on the basis of its polarity.

[1] The publication has been co-financed from funds granted to Faculty of Management, Cracow University of Economics, for supporting scientific research capability and for the development of young scientists and Ph.D. students.

- Feature-based opinion mining and summarization – discovering what aspects of product users like or dislike.
- Comparative sentence and relation mining – analysis of sentences comparing directly one product to another.

Opinion mining covers therefore a wider range of actions than sentiment analysis, aiming to perform complete analysis of opinions and not only its polarity determination. The work presented in this paper is rather a part of opinion mining as it aims not to determine the attitude of opinions author to the subject of opinions but to describe how users perceive the product. It may also be considered as a part of feature-based opinion mining as it helps to distinguish products features that are important for users.

Opinions can have written or oral form, however opinion mining is mainly interested in analysis of textual opinions as there are many of them available in the Internet and there are tools designed for natural language processing, computational linguistics, and text analytics that can be used in opinion mining. Opinions that can be found in the Internet are specific type of textual data. The development of mass media and especially the Internet has influenced the form and availability of customer opinions. The most significant change concerns the transition from the passive to active expression of opinions characteristic for the contemporary information society. Nowadays we can find opinions not only on different online shops, online auctions services, opinions services etc. but also on products websites, newspapers or magazines, discussion boards, mailing lists, forums, blogs (Dave et al., 2003) and social medias (Wójcik, 2012).

There are few text mining approaches to opinion mining (Lula & Wójcik, 2011):

1. Word-based approach – it is assumed that the meaning of the opinion is carried by separate words; in this approach tools like tokenizers, different kind of machine-readable dictionaries, shallow parsers, disambiguation tools etc. are used.
2. Pattern-based approach – it is assumed that phrases/expressions can have different meaning than separate words from which they are built; in this approach tools based on regular expressions and valence dictionaries can be used.
3. Ontology-based approach – in this approach an ontology is used to represent domain knowledge about the subject of opinion; it allows to show the structure of product or service which is rated in opinion.
4. Statistical learning approach – it is used in sentiment analysis, mainly in opinions classification; in this approach training set (containing opinions with sentiments given) is required; on this basis the model learns how to assign polarity to new opinions.

The best results can be achieved in multi-model approach where advantages of each method can be used to automate the analysis in another approach. Word-based approach can be used in features identification. All nouns used in opinions can be extracted. Then from most popular of them the selection of those describing product or service features can be done. Pattern-based approach allows to group words into phrases or to identify relations between words. The ontology as graph-like construction makes feature based opinion mining easier to conduct. Ontology helps in creation of feature hierarchy and in presentation of other relations between products and their features. At the same time it is possible to examine how often and how much detailed features are rated in opinions.

The growing need of ontologies caused the development of ontology learning – the process supporting the constructions of ontologies and populating them with instantiations of both concepts and relations (Lechman & Volker, 2014). Ontology learning is usually semi-automated process

because the more humans are involved in the ontology creation process the better results are achieved. There must be a compromise between time spared on ontology preparation and its quality.

In the literature two major approaches to ontology learning can be distinguished:

- Ontology learning from text – automatic or semi-automatic generation of lightweight[2] ontologies using text mining and information extraction techniques
- Re-use of ontologies – attempt to adapt parts of already defined ontologies from one domain to another.

Meadche and Staab (2001) proposed in their paper an architecture for ontology learning which consists of few modules (e.g. Management component, resources processing component, algorithm library) realizing ontology learning process comprised of the following steps:

1. Import and re-use of existing ontologies,
2. Extraction of data (from sources of different types),
3. Prune of created ontology,
4. Refinement of ontology.

Our approach presented herein generally matches the above architecture with the exception for the first point: it does not use any prior existing ontology but instead it generates a network of terms de novo by processing textual opinions.

3. Proposed analysis workflow

In the context of this paper we adopt a simplified concept of lightweight ontology reduced to a set of named types without any attributes and relationships with the exception for basic association. Such minimalistic interpretation is chosen in order to match the structure of expected results with practical capabilities of automated text processing and analysis. This skeletal form of ontology, or semi-ontology, consists solely of entities representing parts, features and usages of a certain product which can be expressed with nouns. Over these entities a binary symmetric relation is defined which includes all unordered pairs of entities which are associated with each other. The only criterion for detecting associated pair is based on the distance between occurrences of entity names in the written text. Associated entities are therefore linked at best only syntactically but not semantically and the relation has no semantic interpretation as being a part, an attribute, a generalization etc.

These simplifications are necessary, at least on this stage of research, to allow for automated construction of ontology with the use of unsophisticated computer tools applied to processing opinions written in Polish language and acquired from Internet sources. Both factors, Polish provenance and Internet origin, are important source of problems with fully automated textual analysis. Polish as a fusional language poses a non-trivial problem of disambiguating lexical categories of words which are morphologically identical, however this problem is aggravated by poor quality of writing which is common in the Internet community. Writers often choose wrong inflection forms, make grammar and spelling mistakes and rarely review their opinions before posting them online. They also tend to misuse or even completely abandon using punctuation, diacritics and capital letters.

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[2] Wang et al. (2012) proposes the classification of ontologies into formal and lightweight. According to them data models, XML schemas, formal taxonomies, frames, description logics and general logics are formal ontologies while glossaries, web dictionaries, thesauri, structured glossaries, database schemas, user classifications and principled, informal hierarchies can be called informal or lightweight ontologies.

It makes sometimes difficult to understand the exact meaning of written text even for native Polish speaker, not to mention automated analysis.

Our approach is therefore to choose simplified idea of semi-ontology in order to shift the weight of interpretation problems from the input text analysis phase to the output phase of analysing produced results. The ontology itself can be modelled as a simple undirected graph which is unable to capture semantic relations between words but still can describe the network of components and features which users are mentally navigating when describing products and their opinions about them. Edges in the graph can be weighted reflecting the frequency of occurrence of associations and further enriching the ontology.

Annotating noun associations with roles, such as being a part of a whole or being a generalization of a concept, is in our opinion impossible without resorting to some external ontology known in advance. However we would like the proposed method to remain self-contained thus the only option to recognize association roles, at least partially, is to decipher them from grammatical dependencies between nouns, optionally including also other words. This strongly depends on writers being precise and consistent in their choices of words and grammar structures. However in our experience the language of opinions posted online resembles mostly spoken language, which is often inconsistent in conveying the same meaning with several expressions which in formal written language denote distinct concepts. Internet users who write opinions are also generally negligent about choosing proper grammar forms and structures adequate to semantic relationships between words, or perhaps they are simply unaware that prepositions, pronouns and other auxiliary phrases have deeper meaning instead of being simple binders between words.

The main purpose of the method proposed in this paper is not discovering comprehensible product ontology but rather capturing the most prominent associations between concepts, entities and features perceived by product users and articulated in their opinions. Resulting semi-ontology is intended primarily not for standalone use but for confrontation and comparative analysis with other ontologies obtained in the same manner, for example in comparing different products on the basis of user opinions sharing common origin or in comparing user groups on account of their opinions about the same products. Therefore ontological relevance of generated noun graphs is considerably less important than their repeatability and simplicity.

The entire workflow of analysis and ontology generation consists of two separate stages. In the first stage the corpus of opinions undergoes text processing which results in detecting noun associations. In the second stage a graph of associations is constructed and then subjected to further processing. Both stages use different methods as linguistic tools are involved only in the first stage while the second one employs only graph-related operations. The text processing stage is expected to produce excessive list of candidate associations, some of them being falsely recognized as nouns and some other occurring only accidentally. Consequently the list must be refined, first at the text processing stage when spurious nouns are filtered out and then again at the graph processing stage when casual associations are pruned. The sequence of operations can be summarized as follows:

1) Text processing stage
   a) preprocessing
      i) punctuation removal
      ii) case unification
   b) parsing and nouns detection
   c) building association list
   d) linguistic refining

   i) noun disambiguation
   ii) removing verbs
   iii) removing proper names
   iv) handling exceptions
  e) merging synonyms
2) Graph processing stage
  a) building association graph
  b) topology refining
   i) edge weight filtering
   ii) vertex degree filtering
   iii) connected components analysis.

4. Text processing stage

The initial step in text processing stage prepares the text samples obtained from opinion source for actual parsing. Preprocessing is required for two reasons, first to remove characters and strings which are not words, for example numbers and emoticons, and second to unify structure of text samples. All characters not being Polish alphabet letters are removed, including all punctuation marks. In well-formed written text punctuation is important in recognizing noun association, especially when two nouns are separated with comma or period. As it was mentioned earlier however, opinions collected from Internet sources often have poor or misleading punctuation and for this reason our strategy is to ignore punctuation at all and allow spurious noun associations to be detected for example on the boundary of sentences, because they will be refined in later processing. Analogously the entire text corpus is transformed to lowercase to unify spelling which is also very diverse among opinion writers.

After preprocessing the text is parsed with SPEJD engine and nouns are identified according to a simple criterion: every word which can be matched with any inflectional form of some noun is considered a noun. The next step is to build the list of associations by enumerating all words in a sequence of occurrence and measuring the distance between consecutive nouns, counted in whole words. Two directly adjacent words have a distance of 1. If the distance between two consecutive nouns is at a certain threshold or below, these nouns are treated as associated. Typical use of pronouns, prepositions and other word categories in Polish language causes that two related nouns can become separated by at least one additional word. Therefore we assumed the threshold of 2. The relation of association must be symmetric because word order permutations are very common in Polish and without complex syntactic and semantic analysis it would be impossible to reliably determine which word is the source and which is the target of an association. A noun can be simultaneously engaged in two associations with its predecessor and successor thus forming whole association chains.

The next step is refining the collected list of associations. This includes disambiguation of words which can be matched with more than one noun. SPEJD engine is able to detect such situations, however the choice of correct word is left to the user. In our method if two or more nouns are matching, the one is chosen which has the highest frequency of occurrence in analyzed corpus. Special care should be taken for auxiliary and modal verbs and some other parts of speech which can be incorrectly classified as nouns due to their morphological similarities. Fortunately the set

of such problematic words is stable and can be enumerated as a list of exceptions which can be removed from resulting ontology automatically or manually at later stages of opinion processing. Similar issue concerns proper nouns and it can be solved analogously.

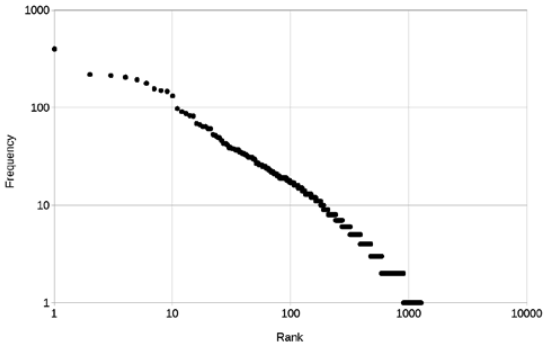
Detecting and handling groups of synonyms is a little more complex task. There are two possible approaches to it, eager and lazy disambiguation. The former aims at replacing all synonyms as early as possible, at the text processing stage while the latter approach postpones disambiguation until topology refinement during graph processing stage. Lazy disambiguation could be less costly after reducing the graph to a small number of vertices because fewer words would require checking. On the other hand eager disambiguation could produce initially smaller graph thus facilitating its subsequent processing although more words should be checked for equivalence. Currently in our experiments we perform disambiguation manually and for this reason we decided to choose lazy strategy.

Processing synonyms is necessary because opinion writers tend to use them for stylistic reasons so as to avoid their text appearing too formal or official. They often use diminutive nouns, jargon or colloquial expressions. Automating the task of merging all synonyms, besides being one of the most challenging problems of natural language processing, would require a dictionary not only up-to-date with current usage trends of specific words, which can change very rapidly in some domains, but also fine-tuned to specific kind of products being reviewed in opinions. It would, in fact, require a complete developed ontology equipped with synonymic relations between concepts and words which denote them. This in turn would make our intention of retrieving ontology from opinions entirely pointless. Therefore our stance is that automated processing can cover only truly unambiguous diminutives, augmentatives, jargon and colloquialisms while leaving other cases to human judgement.

5. Graph processing stage

Noun association list obtained in the text processing stage is afterwards used as an adjacency list to create the semi-ontology graph. Each unique noun occurring in the list becomes a vertex and pairs of nouns are treated as edges. Whole association chains are translated to entire paths in the graph. Several pairs can occur more than once in the corpus and should be merged appropriately by increasing weights of corresponding edges. Therefore the weight of an edge in the graph is proportional to the frequency of incident nouns appearing in direct proximity regardless of their order. Consequently the weighted degree of a vertex is proportional to the frequency of involvement of corresponding noun in any kinds of noun pairs. This allows for filtering the graph in order to extract the most relevant semantic structure while discarding unimportant and accidental word collocations. It is expected, due to simplifications assumed in the text processing phase, that the graph directly obtained from noun association list will be overloaded with spurious and irrelevant relations and said filtering is used as a countermeasure.

Figure 1. Rank-frequency graph of nouns in association list



Source: own elaboration.

The two most basic filtering methods are vertex degree filtering and edge weight filtering. Vertices with degree 1 are analogous to hapaxes in text corpus analysis and they are the most numerous group of vertices. The frequency of nouns selected in the association lists roughly follows Zipf's law (Fig. 1) which is not surprising as nouns are one of the most frequent parts of speech occurring in written texts. Each occurrence of a noun on the association list results in incrementing its vertex weighted degree. For this reason weighted degree distribution also approximately obeys Zipf's law. This means that by removing vertices with low degrees and retaining only vertices within the top portion of degree distribution the graph can be greatly reduced while preserving the most frequent targets of semantic relations. Highest degree vertices are acting as hubs connected with low-weight edges with a great number of different nouns occurring only once in the corpus, it is therefore likely that they represent broad and important concepts which can be paired with a large variety of supplementary words augmenting their meaning. These hubs are also more likely to appear accidentally near a random unrelated noun what makes vertex degree filtering a necessary step in graph processing.

The other method of filtering is based on edge weights which have different distribution than vertex degrees. Edges with weight noticeably greater than 1 connect nouns which tend to occur consistently in the same pairs so it can be assumed that they represent stronger association of two concepts than edges occurring only once in the corpus. It is important to note that edge weights and vertex degrees are not necessarily coupled because they correspond to different dependencies. A noun which serves as a conceptual hub may have hundreds of low-weight edges originating in it but no permanently attached complementary concept generating more repetitions and higher edge weight. Conversely, a tightly coupled pair of nouns may repeat often thus raising its edge weight but it also may have very few other nouns associated resulting in low degrees of both pair elements. Both filterings can be therefore applied independently and by changing weight and degree thresholds the level of details can be adjusted both in the domain of noun pairs diversity and their strength.

Whether filtered or not, the graph may contain more than one component. It is possible and even expected because opinion writers rarely hold on to a single topic and often use diverse figures of speech such as metaphors and analogies to illustrate their statements or liven up their style. The domains of metaphors used can be completely disjoint from the domain of reviewed product

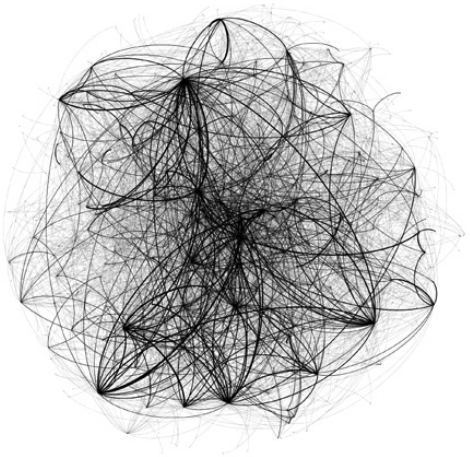
and nouns from that area may never occur in proximity to nouns related to the product. Partitioning the graph into connected components can reveal additional structure which can comprise a single giant component and several microcomponents or a more diversified collection of component with various sizes. The distribution of connected component sizes may allow to infer about homogeneity of writers and their opinions or may expose internal heterogeneity of the product being reviewed.

6. Experimental results

Text and graph processing workflow described above have been applied to the corpus of 737 opinions about specific smartphone model collected from Internet sources cokupić.pl via ceneo.pl. The analysed opinions were all written in Polish language and followed the same scheme containing product advantages, disadvantages and a short summary. Opinions from the source were extracted using DOM parser for PHP language. Then in the preprocessing stage tm package for R language was used. The next tool that was used in experiments was SPEJD which is a tool for simultaneous morphosyntactic disambiguation and shallow parsing (Buczyński & Wawer, 2008). It uses the National Corpus of Polish Language. Finally a custom JAVA application was used for analysing and processing results produced by SPEJD.

The resulting semi-ontology in its entirety consists of 1300 nouns and 4300 edges what makes it unwieldy for presentation (Fig. 2). Besides small number of disconnected 2- or 3-node components the graph contains only one giant component connected with edges with weights ranging from 1 to 5. This means that analysed opinions were very diverse linguistically and contained a great variety of nouns rarely repeating in the same configurations.

Figure 2. Full graph (1300 nouns, 4300 edges)



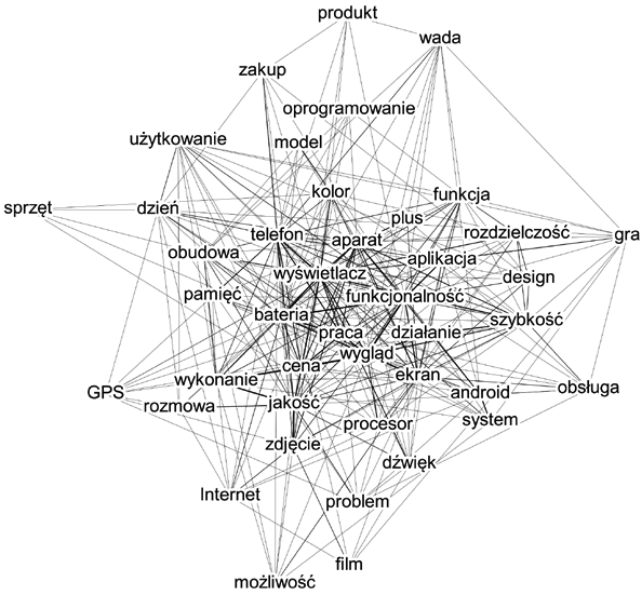
Source: own elaboration.

However, applying vertex degree filter helps to reduce the ontology to a much more comprehensible size. Several nouns have very high degree, even up to 325, which means that they occur together with 25% of all distinct nouns in the corpus. These hubs are the least numerous vertices

and the most common are nouns with very small degrees, so filtering out only lower 10% of degree range leaves 3.2% nouns and 7% edges remaining in the form of fully connected graph (Fig. 3).

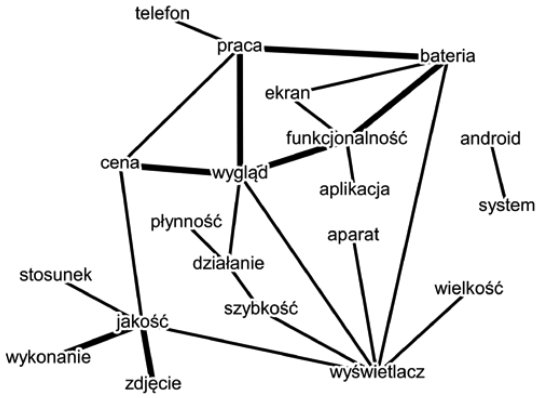
Degree-filtered ontology still contains very dense network of edges which makes it difficult to analyse. The other kind of filtering helps to resolve this issue by removing vertices connected to the rest of the graph with edges having too low weight. Again, low weight edges are the most common and for example by filtering out lower 60% range of weights a highly condensed version of the full graph is obtained, with only 1.5% nouns and 0.6% associations remaining (Fig. 4). This version of ontology can be interpreted much easier as it captures only the most prominent associations between nouns. It also illustrates the case when the graph contains disconnected components representing disjoint concepts (operating system versus usage experience).

Figure 3. The effect of removing nodes in lower 10% degree range (42 nodes, 298 edges)



Source: own elaboration.

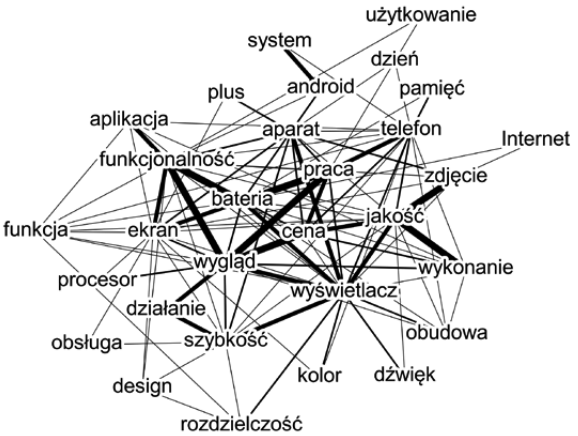
Figure 4. The effect of removing edges in lower 60% weight range (20 nodes, 24 edges)



Source: own elaboration.

Both filtering methods can also be applied simultaneously producing a graph of intermediate complexity, for example generated smartphone ontology can be reduced to 2.5% of nodes and edges by removing lower 10% of vertex degree range and lower 20% of edge weight range (Fig. 5).

Figure 5. The effect of removing both nodes in lower 10% degree range and edges in lower 20% weight range (30 nodes, 108 edges)



Source: own elaboration.

The interpretation of ontology graphs is strongly domain-dependent as they consist of nouns most characteristic for given domain, and noun pairings reflect relations specific for the domain. For example nouns occurring in opinions about electronic devices would reflect functional and structural dependencies found in their design, as it can be seen in our experiment (vertices with

the highest degrees represent such product aspects as "price", "appearance", "functionality", "quality", "battery", "display", "performance", "size" etc.). On the other hand it could be expected that ontologies created from movie reviews would capture important concepts of the plot while processing opinions about travel agency would result in ontology of prominent tourist attractions in popular travelling destinations.

For these reasons it is difficult to provide generalized interpretation of degree- and weight-based filtering effects other than quantitative one. Vertex degree filtering is helpful in selecting only the most often commented concepts, however applied alone it cannot reduce the complexity of graph edges, most of which are spurious weak associations caused by accidental co-occurrence of nouns (for example "purchase" and "design" on Fig. 3). On the contrary, edge weight filtering is much more powerful in reducing graph complexity because it preserves only those concepts which are strongly associated together through occurring in the same pairs frequently thus not accidentally (for example "price" and "quality" on Fig. 4). Nevertheless edge weight filtering tends to remove concepts which are important for opinion writers but not directly associated with other single concept (for example "flaw" on Fig. 3). Such loose concepts are often mentioned close to other concepts (they have high degrees) but their associations are unstable and weak (they have low edge weights). Therefore combining both filtering methods seems to be better choice although it requires some experimentation before finding optimal thresholds, characteristic again for given opinion set and its domain.

7. Conclusion

Textual analysis and noun graph construction workflow proposed in this paper can be regarded as a simple method for automated semi-ontology generation which produces a network of noun associations based on their local co-occurrence. This method is designed mainly to process corpora consisting of short text fragments with the same recurring topic, for example customer opinions about the same kind of products. Compared to similar method of analysing the set of most frequent nouns the semi-ontology approach provides structured network of nouns reflecting the popularity of entire word pairs instead of single words. The downside of proposed method is its sensitivity to low quality of writing and lexical ambiguity, however it can be compensated by graph filtering and further manual analysis and interpretation.

The method proposed can be used as a tool for exploration of product features which are actually important to customers. It can help in better choice of targets and methods in product marketing or it can serve as a feedback measurement tool for checking whether currently adopted marketing approach has real impact on customer opinions. It could also be utilized, at least conceptually, for automated deciding whether a product opinion is genuine or written by hired writer by measuring the degree of its conformance to the typical ontology specific to that kind of products.

Ontologies generated by noun pair analysis are not sentiment-oriented because nouns are rarely expressing subjective attitude towards product features and they need other parts of speech to specify whether specific feature is satisfying or dissatisfying. Further development of the method can include adding adjective and adverb recognition as well as the conversion of verbs and other parts of speech to nouns denoting corresponding concepts.

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Chapter 22

Enhanced Firefly Clustering Algorithm as an Effective Tool for Cluster Analysis[1]

Paweł Wołoszyn, Janusz Morajda

1. Introduction and literature background

Cluster analysis is an important branch of data mining processes. It is frequently applied in many scientific disciplines, also in business and economy, for example in enterprise grouping or customer classification. The terms: *cluster analysis*, *clustering* or *grouping* refer to dividing the given set of objects into disjoint, homogeneous groups (clusters) composed of similar elements, so that two objects belonging to the same cluster are more similar to each other than two objects belonging to different groups. Cluster analysis is performed to discover structures in data without *a priori* knowledge about them, i.e. without any theory or explanations concerning existing structures (clusters). Clustering engages a number of different methods. An important approach to the problem involves hierarchical techniques based on agglomerative or divisive algorithms. Such tools lead to creating a tree-like structure called *dendrogram*.

There is a number of non-hierarchical (partitional) clustering methods. Here the most typical representative is the *k*-means algorithm, early presented in 1957 and successively developed (Jain, 2010). The *batch* variant of the *k*-means procedure is called Forgy algorithm or H-MEANS heuristic (Spath, 1980); another *k*-means version is named BISMEC or K-MEANS (Spath, 1980; Wierzchoń & Kłopotek, 2015). Many other variants of this method have been developed, e.g. online algorithm (Barbakh & Fyfe, 2008), bisection variant of *k*-means (Steinbach et al., 2000), and other. Also, it is worth mentioning the relatively wide adoption of fuzzy approach to clustering, introduced in (Ruspini, 1969) and resulting in development of fuzzy *c*-means algorithm.

Cluster analysis methods have been discussed in many classical monographs, e.g. (Anderberg, 1973; Hartigan, 1975; Spath, 1980; Kaufman & Rousseeuw, 1990; Gordon, 1999; Cichosz, 2000; Everitt et al., 2001) as well as in recent books: (de Oliveira & Pedrycz, 2007; Kogan, 2007; Aggarwal & Reddy, 2013; Wierzchoń & Kłopotek, 2015) and other.

Here we submit an enhanced clustering method, which we originally proposed in (Morajda & Wołoszyn, 2015) and named *Firefly Clustering Algorithm* (FCA). Actually this method cannot

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be clearly assigned either to hierarchical or to partitional techniques – it reveals features connected with both groups of clustering methods. The FCA is based on a recently developed and widely applied optimisation technique known as Firefly Algorithm (FA) which is inspired by natural behaviour of living fireflies. The FA is briefly outlined in Section 2. Section 3 describes the details of enhanced FCA – the proposed clustering algorithm inspired by FA. Sections 4 and 5 present some empirical clustering experiments concerning applications of enhanced FCA to selected datasets, and discuss research results. Final conclusions are presented in Section 6.

2. An outline of the optimisation Firefly Algorithm

Firefly Algorithm (FA) was created by X.S. Yang (Yang, 2008; Yang, 2009) as a tool for solving complex optimisation tasks. It is a nature-inspired procedure that simulates the behaviour of fireflies which emit light and move towards other luminescent individuals. FA is based on the following assumptions rules (Yang & He, 2013): fireflies are unisex (a firefly is attracted to other ones regardless of their sex); the attractiveness is proportional to the brightness (decreases as the distance between fireflies increases); for any two fireflies, the less brighter one will move towards the brighter one (if there is no brighter one, the firefly moves randomly); the brightness of a firefly is determined by the landscape of the objective function.

Consequently, the main idea of FA is that a firefly is attracted to any other firefly that has a higher brightness. The strength of this attractiveness is conversely proportional the distance between the fireflies. As the brightness (and attractiveness) of a firefly is higher if the value of the objective function is better, the moving fireflies tend to find optimal feature vectors in the feature space. Consequently, after a number of steps, some fireflies are positioned very close to global extremum of the objective function. So the FA can be regarded as a metaheuristic optimisation procedure.

3. The FCA algorithm

Let us consider a set of objects (observations) expressed as points (vectors) in the feature space. The goal is the identification of groups (clusters) of objects, having no *a priori* information about possible clusters, their shapes and their number. We assume that each observation becomes a firefly, which can move according to the general rules of the classical firefly algorithm. Consequently, the whole set of observations becomes a dynamic system and its behaviour is simulated during subsequent steps of the algorithm.

3.1. The model

The basic entity in the model is a single firefly which initially, at the beginning of simulation, represents a single sample from the observations set. The properties and behavior of this abstract firefly are only loosely inspired by its biological prototype and can be divided into features related to its physical and social behavior. Physical properties include:

- position – a firefly occupy a single point in the observations space and it does not have any size as its diameter is zero. Initially fireflies are located exactly at observation vectors.

- luminance – each firefly emits light constantly and this dimensionless value describes the intensity of light emitted. Luminance does not change between the events of collision and aggregation of fireflies.
- movement – fireflies move during simulation as if immersed in linear damping medium where velocity is proportional to the force which causes movement while firefly mass and inertia are negligible. This assumption is motivated by the fact that fireflies actively control their velocities instead of passively responding to forces. It also simplifies numerical simulation.

Firefly properties related to social behavior include:

- perception of light – which in turn serves as a method of distance perception. Light emitted by fireflies propagates through the media surrounding them and becomes attenuated exponentially with distance traveled according to Beer-Lambert law. Peers located closer to a firefly appear brighter to it and if it moves so as to keep perceived luminance at the same level, it keeps fixed distances from them at the same time.
- neighborhood – each firefly has at least one neighbor and interactions between fireflies occur only within their immediate neighborhood. Unrelated fireflies do not attract or repel each other. The graph of neighborhood relations is established once at the beginning of simulation by carrying out Delaunay triangulation on the set of observations. Two fireflies become neighbors thus creating an edge in the graph only if they are joined by an edge of some triangle. In other words, two fireflies are neighbors if their corresponding Voronoi cells are adjacent.
- attraction – fireflies can form mate pairs between brightest neighbors which become then attracted to themselves. Mate relation must be symmetric which means that each of paired fireflies must appear as the most luminous neighbor to the other one. A firefly can become engaged only in one mate pair at the same time and in case of ambiguity the mate is chosen arbitrarily in the model.
- aggregation – fireflies engaged in a mate pair are attracted to themselves and start flying towards each other until they collide. In the result an aggregate is created which consists of both mates henceforth permanently bound together. The aggregate then behaves exactly as a single firefly and the population number decreases with each collision. Luminance of the aggregate is determined on the basis of mate luminances using some kind of strategy adopted in the particular experiment, for example as a simple sum. The most minimalistic strategy is to leave all luminances unitary both in single fireflies and their aggregates. After aggregation the neighborhood graph is updated by merging corresponding vertices.
- distance keeping – neighboring fireflies which are currently not involved in mate relationship try to keep the distance between them constant, just as if they were connected with some kind of elastic rod. If their separation decreases, a repelling force appears tending to restore the original distance and conversely if they drift away, an attracting force appears. In opposition to that those fireflies which are engaged in mate pairs behave as connected with strong and shrinking chain and therefore the movement towards mate has higher precedence. The elasticity of imaginary neighbor-to-neighbor link is necessary for allowing convergent movement of mates because otherwise the entire graph of neighbors would be completely rigid as composed exclusively of triangles. It should be emphasized that only direct neighbors observe their distances and spacing between other fireflies is ignored even if they fly close to each other.

3.2. The simulation

The life cycle of the model comprises three consecutive phases: initialization, simulation and analysis. In the first phase the model is initialized with newly created population of fireflies. Each individual is associated with one entry from the input dataset and its position is set to that observation vector. Initial luminance of each firefly is set to the value of 1. After creating all fireflies the neighborhood graph is created by computing Delaunay triangulation on the set of firefly positions. For each firefly its neighbors are recorded along with their initial distances.

Next the second phase begins which encompasses the dynamic part of the model life cycle. The simulation consists of several rounds during which the fireflies are paired, moved, collided and aggregated into larger units. Simulation mechanism is purely deterministic and no random input is used although in the case of symmetric ambiguity an arbitrary choice is made based on the ordering of input data.

A simulation round is further divided into three stages:

- Stage 1: Choosing mate pairs

Fireflies check perceived luminance of all their direct neighbors and choose the most luminous of them as a mate candidate. If all neighbors have the same real luminance, in particular if they have retained their initial luminance equal to 1, the candidate appearing as the brightest is also the nearest one. However, in more complicated scenarios aggregating fireflies can build up higher values of luminance and the choice of candidate becomes a combination of distance and luminance criteria. It is then possible that more distant neighbor becomes the chosen one in spite of other peers being closer to the choosing subject.

After choosing candidates they become verified for symmetry. Any two fireflies which are mutually their own candidates become a pair of mates. All other fireflies abandon their choices and remain not paired until next round. Each pair of mates is joined by an edge in the neighborhood graph. Required symmetry of candidates in the case of uniform, not aggregated luminance results in such choice of mates that they correspond to local minima of edge lengths in the neighborhood graph because all adjacent edges are longer.

- Stage 2: Firefly movement and collisions

This stage is simulated in discrete steps with time interval chosen sufficiently small to assure that system dynamics remain stable and in each step firefly travel length is short in comparison to mean distance between neighbors. Depending on whether a given firefly has a mate or not, its behavior is different. In the former case it just moves towards mate with a constant velocity defined as a parameter of the model. In the latter case it attempts to maintain distances to all neighbors as close to initial distances as possible. Mate movement is symmetric as each member of mate pair moves towards the other and at the same time it ignores all other neighbors and their distances.

The distance-preserving movement of not paired firefly results from adding forces exerted by its neighbors according to the difference between their initial distances and actual distances reached in each simulation step. The resultant force determines direction and speed of movement. It is obvious that initial distances cannot be preserved indefinitely because as a pair of mates approach each other, at least one triangle in the neighborhood degenerates to a line segment. Final length of such segment depends on equilibrium of forces between neighbors and on their geometry and it need not be equal to simple arithmetic mean.

When two mates approach themselves closer than a threshold assumed in the model, they collide and become attached to each other. From now on they behave as a single unit, moving and reacting

again to neighbor interactions as a single, not paired firefly. Each collision eliminates one mate pair and eventually no pairs are left at which point this simulation stage completes, still allowing some extra time for firefly positions to settle in equilibrium before transition to the third stage.

It is worth emphasizing that in the current design of the model fireflies move in space which has only as many dimensions as observation vectors. For example if input data is two-dimensional, fireflies remain bounded to a plane which makes it impossible in most cases to maintain distances when some edges in triangulated mesh are shrinking. In future development of the model one or more additional dimensions could be introduced adding more degrees of freedom to firefly movement and easing the task of keeping constant distances between neighbors.

- Stage 3: Aggregation and neighborhood update

Fireflies which belong to a pair of mates ultimately collide with themselves and aggregate. Other fireflies do not collide even if they incidentally fly very close to each other. Aggregation of collided mates requires two tasks to be performed, combining their luminances and updating neighborhoods, which are done as described earlier. In order to avoid introducing new individuals not existing in the initial population, the aggregate retains identity of one of collided fireflies. Therefore from mereological point of view one of colliding mates becomes the whole while the other is treated as a part, although both of them could already be aggregates prior to collision. The most straightforward strategy to determine which one is the whole is to consider the total count of aggregated flies gathered so far in previous collisions. If both mates are equal in this respect the choice is made arbitrarily.

Aggregation events are recorded in a history log in the order of their occurrence. This allows to reconstruct and analyze the process of cluster formation. In fact two versions of the history are recorded because if a firefly collides with already aggregated mate it can be interpreted as a fusion with either the whole mate or one of its parts. This ambiguity arises when a neighbor of some individual first becomes absorbed as a part in another aggregate before turning into mate of that individual. Hence both versions of history are kept, a neighbor-oriented one with collisions always recorded as encounters with direct neighbors even if they are parts of larger wholes, and second, leader-oriented history with collisions treated as encounters with wholes even if they are not original neighbors. Both histories generate different clustering trees although their subsequent analysis leads to very similar results. This dualism applies only to those fireflies which are considered wholes in the context of a collision. Those which are considered parts remain unambiguously identified as either single fireflies or fireflies given the role of whole in previous collisions.

Finally, when only a single aggregated unit remains in the population, the simulation phase ends and recorded collisions history can be analyzed. In the analysis phase a clustering trees are constructed as directed graphs with vertices representing original observation vectors and edges corresponding to aggregation events and directed from parts to wholes. Neighbor-oriented tree depicts hierarchical structure of neighborhood with more short and local edges between direct neighbors. After several collisions and merges local neighborhoods become exhausted and new neighbor relations are established with more distant vertices. The longest edges in the tree represent collisions between entire aggregates and can be therefore used for partitioning the graph into several clusters. On the other hand leader-oriented tree portrays centers of absorption developing as more and more vertices become aggregated. This kind of trees tend to have longer edges converging into few hubs. Vertices with the highest in-degree can be recognized as cluster leaders and vertices merged with them as cluster members.

As the algorithm starts from a state, where each observation is a single 1-element group, and ends on one cluster containing all objects, the method can be classified as an agglomerative clustering technique, which leads to creation a dendrogram.

3.3. The overview of algorithm in pseudocode

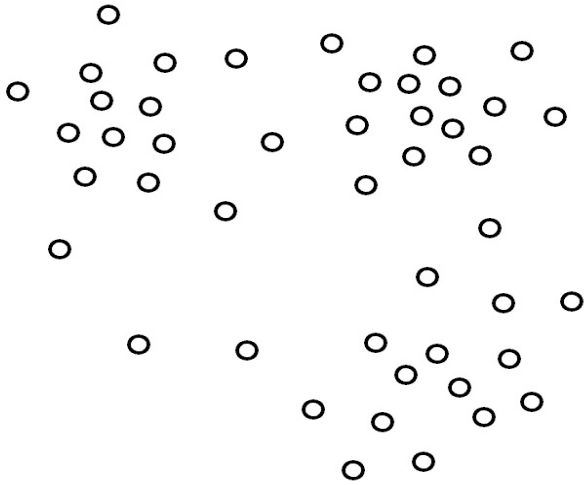
```
for each observation
 add firefly to population P
compute set N of neighbor pairs
while size of P > 1
 initialize empty set M of mate pairs
 for each pair (a,b) in N
      if (a,b) are mutually nearest neighbors
           add (a,b) to M
 repeat
      for each (c,d) in M
           move c and d towards themselves
           if c and d collide
                choose the roles of c and d as whole w and part p
                replace p with w in N
                remove p from P
      for each (a,b) in N
           accumulate elastic force
      for each f in P
           move f
 until equilibrium is reached
```

4. An example of cluster analysis with application of enhanced FCA method

Here we demonstrate results of enhanced FCA performance in a clustering process for an artificially generated dataset. We consider only a 2-dimensional problem, i.e. a dataset with only 2 numerical features (variables), however the method is universal and can be applied for any number of inputs.

Let us consider a set of observations presented on Figure 1. Each observation is described by two features (input variables) and can be regarded as a point in a 2-dimensional space (plane). Small circles in Figure 1 indicate positions of observation vectors which are also initial positions of fireflies.

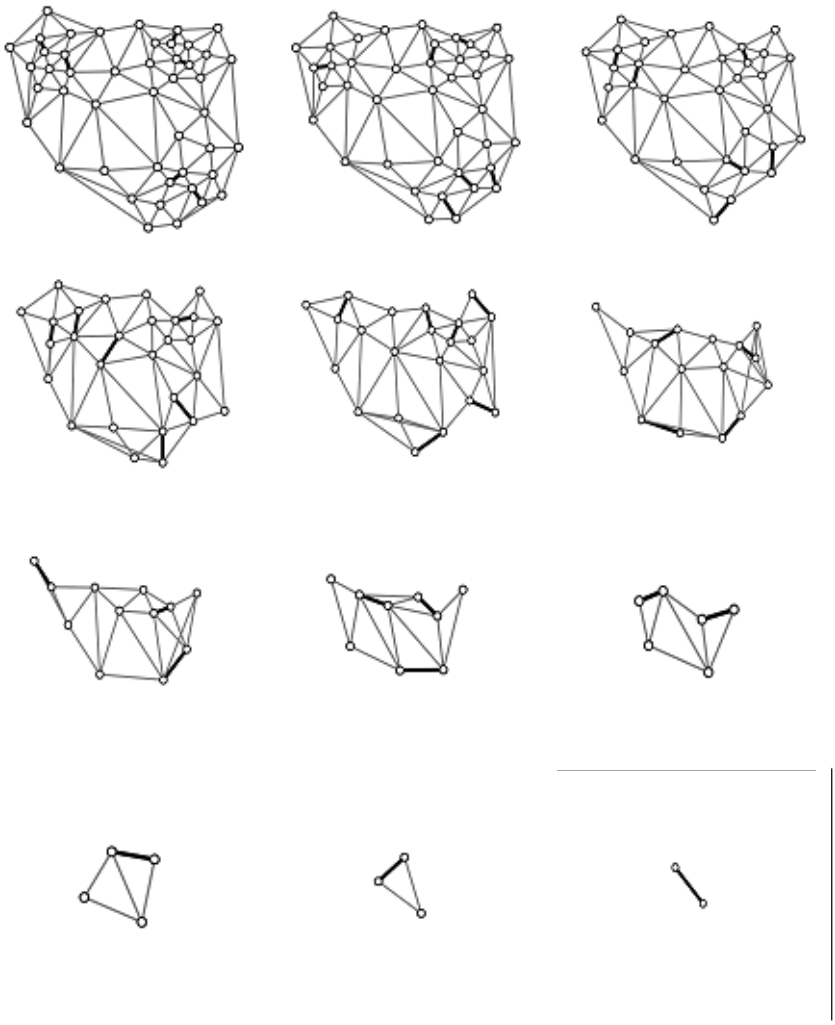
Figure 1. A graphical representation of the dataset



Source: own work.

We have carried out clustering process for this set with the use of FCA algorithm described in Section 3. Figure 2 graphically shows selected subsequent steps of the procedure. Each presented stage of the process is illustrated by currently constituted mate pairs of fireflies (circles linked with a thick line) and other (not paired) fireflies keeping proper distances presented by thin grey lines. Due to aggregation of fireflies, their number decreases in subsequent steps.

Figure 2. A sequence of steps (selected stages) of the clustering process

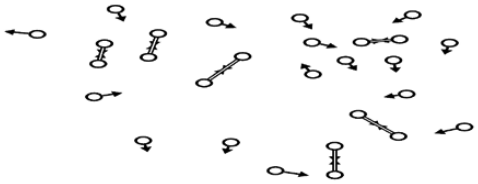


Source: own work.

In order to illustrate forces that impact the fireflies movement we have shown an example of their vectors arrangement (in a selected step of FCA) on Figure 3. Double arrows denote the attraction of currently constituted mate pairs of fireflies, single arrows represent elastic forces that tend to maintain previous distances between neighbouring elements.

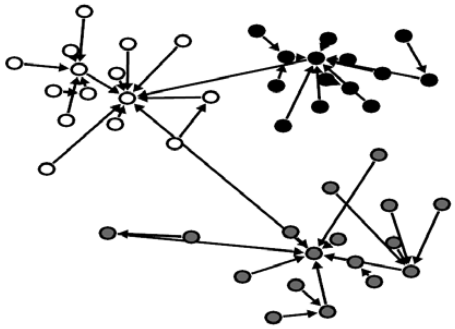
Figure 4 presents the "impact graph" resulting from recording all events of fireflies aggregation. Arrows indicate the relation between parts (arrow tails) and wholes (arrow heads) which are sometimes recursively joined into even larger wholes. Elements with the highest number of incoming arrows can be regarded as the centres of clusters. Cutting the arrows between cluster centres corresponds to cutting the clustering dendrogram at a selected level.

Figure 3. An illustrative configuration of forces affecting fireflies at a selected instant



Source: own work.

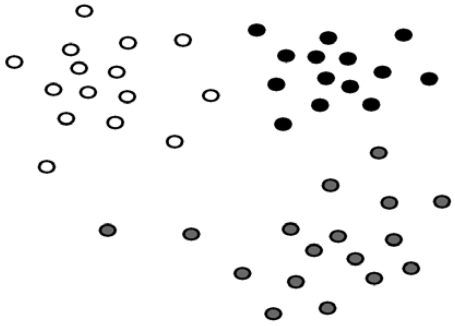
Figure 4. The resulting dendrogram shown as the graph of aggregation history



Source: own work.

The final result of clustering is shown on Figure 5.

Figure 5. The final result of the clustering process; three identified groups are presented with different shading

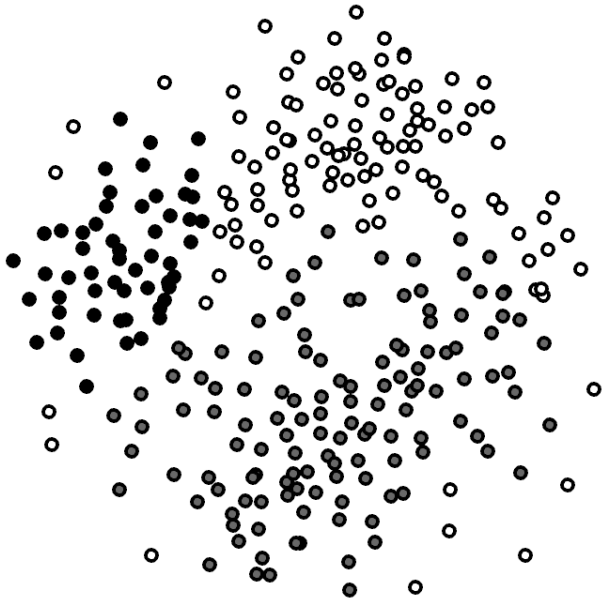


Source: own work.

5. Other examples of FCA clustering

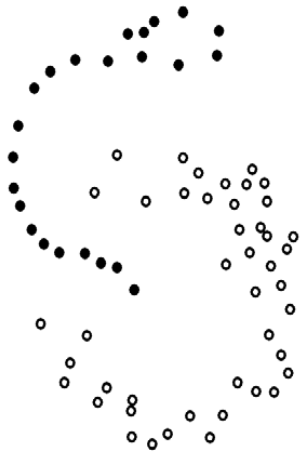
Figures 6 and 7 show results of clustering other selected datasets with FCA method.

Figure 6. The "blobs" dataset and results of FCA clustering (3 clusters)



Source: own work.

Figure 7. The "leaf" dataset and results of FCA clustering (2 clusters)



Source: own work.

6. Conclusion

In the paper we proposed an enhanced clustering algorithm (FCA) based on certain ideas taken from the optimisation FA (Yang, 2008) and on original FCA (Morajda & Wołoszyn, 2015). The enhanced FCA, described in Section 3, performs better than the original FCA, particularly for certain "difficult" datasets.

Obtained results, discussed in Sections 4 and 5, have generally shown the effectiveness of the FCA clustering method. However, as a significant directions of future work, we indicate generalisation of the algorithm to any dimension of the input space, enhancing dealing with outliers, optimisation of certain FCA parameters and visualisation of the clustering process in a dendrogram-like form.

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Chapter 23

A Model for Perceiving Distributed Information Repositories as Integrated System[1]

Dariusz Put

1. Introduction

Information constitutes significant resource for organisations. Often it is distributed and heterogeneous and gathered in many locations with the use of systems having various architectures. Integration of such information resources is a complex and multiaspectual task and may be implemented with the use of diverse solutions. One of the most useful way is a method where the assumption that existing source information repositories remain unchanged is made. When taking under consideration this rule it is necessary to develop a system which integrates data stored in these repositories dynamically in response to requirements formulated by users. Realization of such a task requires solving various problems and developing solutions which ensure transparency and maximum (or even full) automation of the whole process.

In the paper, the main characteristics and the structure of integrating model are discussed. There are two main features of the proposed solution. Firstly, distributed repositories being the source of the whole system remain unchanged, secondly, the solution is perceived by end user as a homogeneous system. The structure of proposed system is described and tasks that have to be fulfilled in the integrating process and methods of their realization are elaborated. Finally, the process of information resources selection in the system based on the proposed model is described.

2. Identification of organisations requiring information integration

Development of tele-information technologies has contributed to the appearance of new organisational forms, e.g. network structures based on mutual connections between companies do not related by capital. The characteristic of such organisational forms is that independent enterprises

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form voluntary, often occasional configurations (Jaruga, 2005). The aim of designing of networks is striving for improvement of operational conditions effectiveness, costs decreasing, growing of competences and so on. As far as benefits for enterprises constituting network structures are concerned there should be mentioned (Barczak et al., 2009; Child et al., 2005; Hacki & Lighton, 2001):

- easier information flow,
- easier access to information,
- the possibility to use information resources belonging to partners,
- the increase of quantity of information resources and easier access to resources and skills belonging to partners.

Such organisational structures have also some weak points, including (Mikuła & Pietruszka-Ortyl, 2006):

- problems connected with mutual connections management,
- increase of transactional costs when the number of network participants grows,
- the possibility to emergence of egoistic and opportunistic behaviour,
- possible exploitation of some partners by those controlling the most important information,
- the problems connected with information management, its safety and security, which is more complicated in network structures than in traditional organisations.

The networks are especially useful when quick and precise information (essential from commercial and social points of view) flow is necessary (Barczak et al., 2009). Such organisations may be of various forms, establishing dynamic structures, often occasional. The structures are (Binsztok, 2005; Pańkowska & Sroka, 2002): clusters, technological parks, process organisations, virtual organisations, fractals. Network organisational forms join distributed and hetero-geneous organisations, so teleinformation technologies enabling fast exchange of data, information and knowledge are crucial for their functioning. So, it is necessary to elaborate and employ adequate process management systems and information systems enabling separate gathering data and information but common their using and exchanging. The network organisational structures dynamically changes, connections between partners are often informal, units, sometimes completely different, are merged, they are organised occasionally in response to appearing market needs, challenges and changing conditions. To achieve such dynamically changing functionality it is necessary to coordinate commonly fulfilled processes, establish connections between applications and systems employed by individual units and appropriately manage of separately gathered information resources. So, information systems designed for such organisations should have at least following characteristics:

- be scalable, which means the ability to enclose new units to the system,
- be flexible, which means the possibility to adjust their structures to changing environment,
- activities and processes should be fully or at least possibly highly automated,
- they should be as user friendly as possible, the structure of user interface has to enable, among other things, uncomplicated access to necessary information resources gathered by individual partners.

Because traditional database systems do not have such functionalities, alternative solutions that enable information resources management in dynamically changing environment in which organisations creating network structures operate have to be elaborated.

3. Shared schema as a core of integrating systems

Traditional information systems, based on central database, are characterised by little flexibility (the structure of a database cannot be changed during a system operation) or even luck of it. In contemporary, quickly changing environment, where, in addition, new information resources appear every day, structures of database systems have to be modified from time to time, which results in increasing costs and many a time in the necessity to redesign the whole system. In systems integrating heterogeneous and distributed information resources the situation is different. In this kind of systems there is a multiaspectual variety: data models, data and information storing systems, query languages, categories and forms of shared resources, names of instances and attributes, methods of instances modification. So, solutions that level out such heterogeneity have to be elaborated. There are some propositions of such systems (e.g.: Stenbit, 2003; Novotný, 2007; Katifori et al., 2005). They have different architectures and are dedicated to integration of different types of information.

Integrating model being a basic for systems enabling linking various information resources repositories has to comprise components that make metainformation about shared resources available, enable uncomplicated search for data and information, choose demanded data and information and present them in legible forms. Such systems have to fulfil a considerable number of tasks, including:

- the communication with external heterogeneous data sources – a solution should enable collection of data and information stored in various repositories,
- reformulation of queries formulated with the use of a query language implemented in the integrating system to query languages used in individual systems,
- linking and unifying information resources collected from heterogeneous resources – data and information received from source systems, even after processing to uniform format (e.g. XML), have to be linked before being sent to users,
- making available metainformation about shared resources – data model that will be used for metadata about shared resources description (ontology) has to be chosen,
- enabling users to access resources – universal solution enables to use shared resources both by previously defined and undefined users and by various applications such as information agents,
- the division of the integration task into possibly independent sub-tasks so that the modification of one of system layers or one of its modules does not demand re-designing of other layers or modules,
- making access to various forms of information resources presentation.

The preparation of a solution for distributed heterogeneous information resources management is more complex than designing traditional systems. Taking under consideration tasks that must be completed by integrating systems based on shared ontology, necessary characteristics of such solutions may be identified:

- they connect independent sub-systems that operate without any changes,
- they provide users with necessary, actual or historical information,
- the process of information resources searching is transparent for users,
- a part of their structure is a flexible shared ontology, so once defined metadata module does not have to be re-designed in the future,
- automatic modification of the ontology is possible,
- not only they enable to predefine queries during designing of a system but also *ad hoc* queries may be formulated,

- the process of queries formulation is as simple as possible, so any user has an access to shared information resources and acquaintance with the query language is not necessary,
- the query language is as simple as possible so everybody may formulate a query,
- the user query language is possibly expressive, which enables to formulate precise queries choosing only necessary information resources,
- they make possible to integrate all categories of information resources,
- they may be used for inter and intra-organisational integration,
- they are scalable which enables to include new sub-systems including clients and business partners repositories during the system operation,
- they do not decrease existing, mainly transactional, systems effectiveness,
- they are easy to design, implement and configure,
- they have layered/modular structure, which enables to modify individual module during the system exploitation without a necessity to change other its elements.

Building systems that have all these characteristics is a complex task, because a considerable number of postulated features are contradictory (e.g. expressiveness and simplicity of query language, not complicated structure whereas the information integration is a complex task). So, when embarking on defining framework for the most ideal integrating model it is necessary to compromise. At first, tasks that have to be fulfilled during accomplishment of such a system have to be identified. Then, the architecture should be designed and operations executed by individual components have to be established. Instructions concerning the modification of components of the system during its operation have also to be elaborated.

4. Example of integrating model based on shared ontology

Due to the complexity of the problem of heterogeneous distributed information resources integration, independently of employed solution, an integrating system has to be composed of modules fulfilling partial tasks constituting the whole process of integration. The proposed model consists of four layers (Fig. 1):

- *local information resources*, comprising integrated repositories,
- *local communication wrappers*, being the interface to those information resources stored in local systems that are made available in integrating system,
- *global*, storing metainformation about co-shared information resources,
- *user interface*, used for communication with users during queries formulation and is responsible for selected information presentation.

Sub-systems constitute the local information resources layer. The proposed model is based on the assumption that the local information resources layer remains unchanged. Such a solution has significant advantages. Transactional and analytical systems gather data and information and make them accessible for various applications and users. Any interference in their databases structures may cause that applications that collect data from the databases will have to be adjusted or will become useless. Furthermore, the process of designing the integrating system may be independent on linked components, so organisations involved in the whole process may operate without any additional problems or troubles. In addition, implementation of a newly created integrating system is not a problem for existing systems and does not influence operational and analytical processes in integrated organisations.

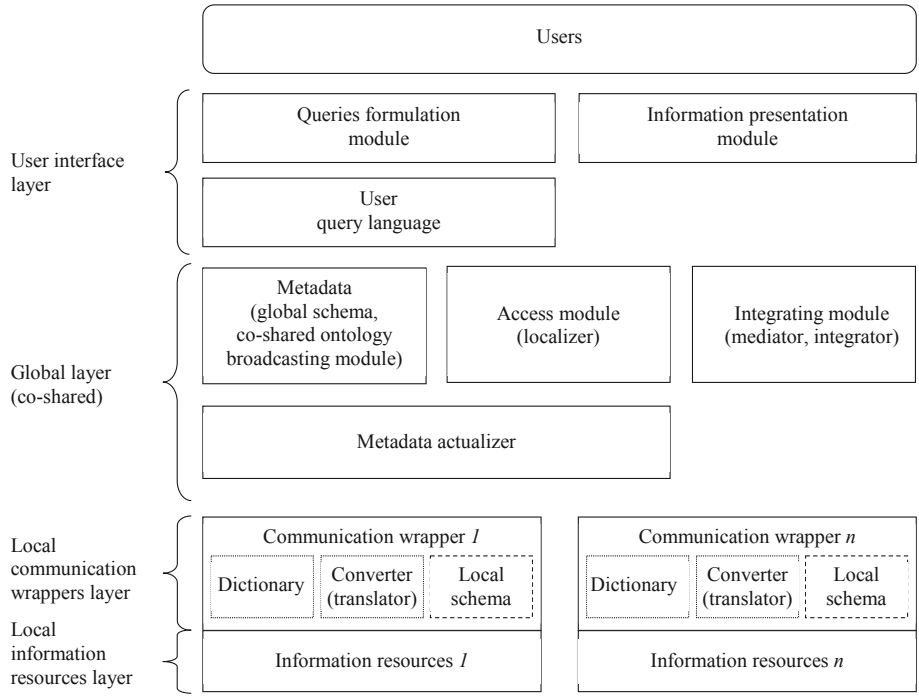
The local communication wrappers layer is designed and implemented independently in individual sub-systems constituting the integrating system based on the discussed model. This layer is an interface to this part of information resources stored in sub-systems that are accessible for all actors. The queries reformulators (converters, translators) are also included into the local communication wrappers layer. Their task is to convert queries received from the global layer and formulated by users to query languages applied in their own systems. They send queries in languages used in this layer, specific for individual sub-systems, to the local information resources layer.

The global layer is designed and shared by all actors. Proper its elaboration will facilitate direct queries formulation by users. It is necessary to achieve a compromise during its preparation, because taking into consideration all aspects connected with data and information access will make the process of queries formulation too complex. The global layer consists of four components:

- metadata module (also called global schema, ontology or broadcasting module),
- access module (localizer),
- integrating module (mediator, integrator),
- metadata actualizer.

The access module identifies sub-systems comprising demanded information resources and sends queries only to identified local systems. The mediator is responsible for integrating resources received from sub-systems in response to users' queries. The metadata module comprises metainformation about all shared resources and their localization in individual sub-systems. The global schema is dynamically modified during the system operation and its actual content is accessible to users in the process of queries formulation. The metadata actualizer is an application which constantly monitors data and information sources and after detecting any changes in the sources automatically adjusts the global schema content so metadata about accessible resources is always up to date.

Figure 1. The architecture of the proposed model



Source: own elaboration.

There are three components of the user layer: the interface enabling queries formulation, the established user query language and the application responsible for presentation of information resources received in response to users' queries. From among three modules comprising the interface layer only one – the user query language – has to be globally defined. Two remaining modules may be standardised or designed locally for or by individual users.

Taking under consideration desirable characteristics of integrating models identified on the basis of existing solutions analysis, the proposed model has the following features:

- the structure consists of four layers,
- every layer consists of modules fulfilling individual tasks that enable users to share information resources,
- integrated sub-systems remain unchanged,
- enables the integration of any database management systems and other repositories,
- metainformation about shared information resources is designed as ontology,
- the structure of the ontology is dynamically modified during a system based on the model exploitation, so it is not necessary to periodically actualise of sharing modules or even to re-design them,
- a syntax of user query language is as simple as possible, so queries may be formulated even by inexperienced users,

- queries execution is two-stage – the query language enables to choose information resources only party processed, they must be additionally transformed by users – this feature of the model is a consequence of the assumption that the user query language structure is as simple as possible,
- during the process of queries formulation it is necessary to have an access to the content of the ontology, which may be fulfilled by graphic interface, so the process of information resources choice is intuitive and user friendly,
- some of tasks fulfilled during the integration process are processed in the local layer,
- design, implementation and exploitation of the system are evolutionary,
- shared modules structures (global and local schemas, localizer) are designed on the basis of XML technology (e.g. RDF, OWL),
- communication protocols have to be established for all modules, so as modules structures may be freely modified.

5. Queries formulation and data selection in the proposed solution

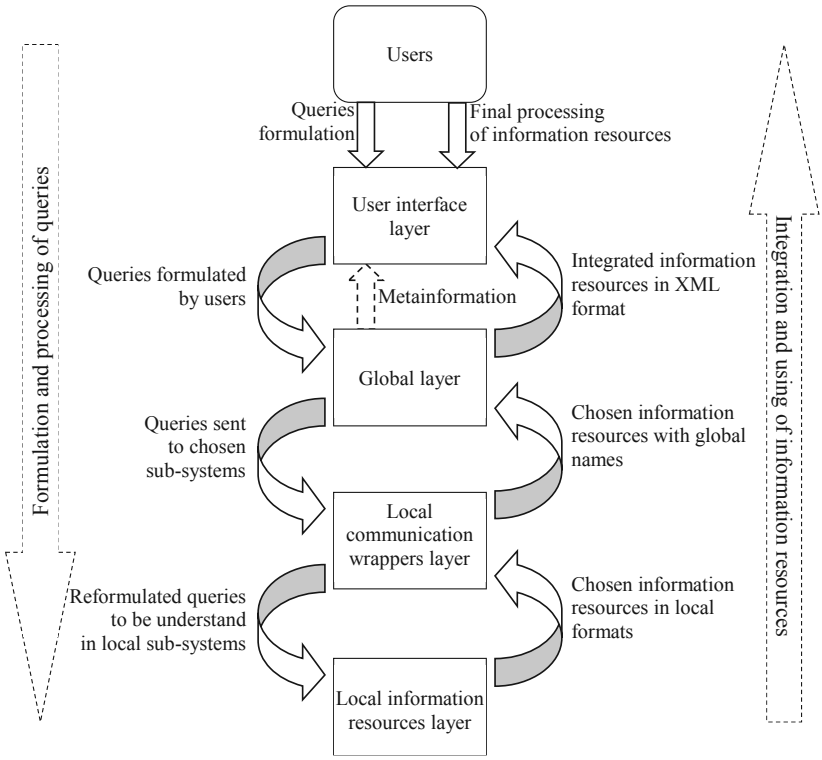
The proposed solution has three crucial features being deciding factors as far as usefulness of information resources integration in dynamically changing environment is concerned:

- one of modules of the global layer is dynamically modified co-shared ontology comprising metainformation about information resources actually available in integrating system,
- local systems constituting the local information resources layer remain unchanged,
- queries processing is two-staged – information resources sent to users in response to their queries have to be finally processed in users' local systems.

The whole process, from queries formulation to sending of selected information resources to users' systems, is automatic. In individual layers following tasks constituting the process are fulfilled (Fig. 2):

- queries formulation (the user interface layer with the use of metainformation about available information resources stored in the ontology),
- sending of formulated queries (the user interface layer −> the global layer),
- sub-system choice and sending queries to chosen sub-systems (the global layer −> the local communication wrappers layer),
- queries reformulation, names translation and sending of converted queries (the local communication wrappers layer −> the local information resources layer),
- the choice of information resources and sending them in untransformed formats (the local information resources layer −> the local communication wrappers layer),
- names negotiation and sending chosen data and information (the local communication wrappers layer −> the global layer),
- chosen information resources integration and sending them to users (the global layer −> the user interface layer),
- final processing of obtained information resources (the user interface layer).

Figure 2. The process of information resources selection in the proposed model



Source: own elaboration.

6. Conclusion

The paper concerns the problem of integration of information resources in cooperating organisations. Situations, where such an integration is necessary was indicated. Then, the complexity of information resources integration in heterogeneous and distributed environment was discussed and the most significant characteristics of integrating systems operating in such an environment were identified. On the basis of this identification the model for heterogeneous information resources, consisting of four layers, were proposed and tasks fulfilled by individual layers and modules were discussed. Finally, the process of information resources integration in the system based on the proposed model was described.

The future work should concentrate on the problem of elaboration of the components of the model in details as well as tasks fulfilled by individual modules in the process of integration. Also, standards for communication protocols should be elaborated which will facilitate creating of individual modules.

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Chapter 24

Measuring the Performance of IT Processes According to the Framework COBIT®5[1]

Jan Ministr

1. Introduction

Most of today's businesses seek to achieve a sufficiently flexible organization that is able to adapt quickly to changing ambient conditions. Process management is now a necessary and important aspect of maintaining the competitiveness of any organization. Unlike functional management the process management puts emphasis on the processes that create conditions, which radically improves the work and activities of employees, which leads to higher performance, and ensures higher quality (Hammer & Champy, 1996). When evaluating the effectiveness of a process, it is important to set goals with measurable indicators. Objective processes are measured by the respective indicators. Without these indicators the company's management cannot confirm whether they meet the objective process or not.

Open standard COBIT®5 (Control Objectives for Information and Related Technology) provides a business view of IT management where information and technology play an important role in the creation of added value for the company. To determine the performance metrics of IT processes can use the goals cascade which translates stakeholder needs into enterprise governance objective and goals, and then further down to IT related goals, processes, and process goals. The paper describes the problem of achieving the highest ROI (Return On Investment) organization's information assets using the methodology framework COBIT®5.

2. Concept of framework COBIT®5

COBIT®5 provides to a company management the complex methodological framework that helps to management of companies to achieve their goals through governance and management. Framework of COBIT®5 supports the creation of optimal values for stakeholders, which represents benefits to companies with optimal level of risk and use of IT resources. The said approach can, however, in the opinion of the author of this paper, applied not only in the field of IT, but also

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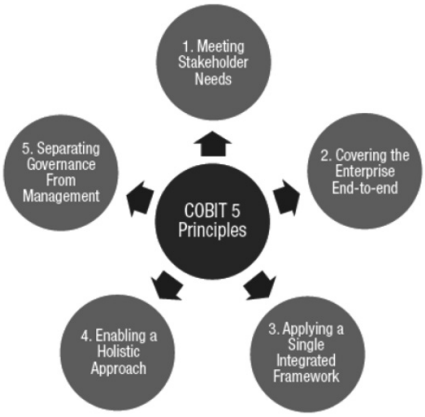
generally in the all process of corporate governance, as evidenced by the five principles on which COBIT®5 is based. These principles are complementary as shown Figure 1 and follow (Bernard, 2012):

- meeting stakeholder needs,
- covering the enterprise from end-to-end,
- applying a single Integrated Framework,
- enabling a holistic approach,
- separating governance from management.

Application of these principles is the same in various large of companies (large, medium and small).

Figure 1. Principles of COBIT®5 framework



Source: (Bernard, 2012).

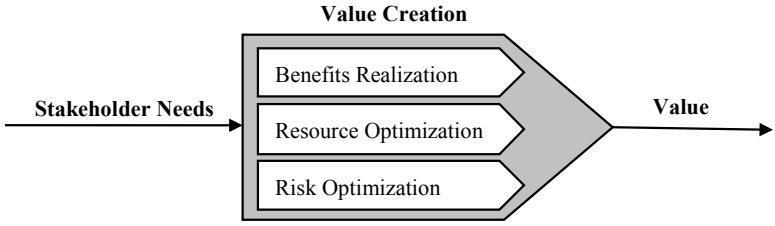
2.1. Principle 1: Meeting stakeholder needs

Stakeholders (every interested party) have their interests and needs. Sometimes they are the same, sometimes contradictory. These interests and needs are there for the stakeholders for its own value. It is expected that any company, to a certain extent, attempts to provide a given value. The value arising from the obtained benefits that are achieved using:

- optimal expenditure of certain funds and resources to ensure the value achieved was the highest,
- ensure reasonable risk levels relative to the value obtained.

COBIT®5 identifies in general the needs of stakeholders and with "cascading" is translated into organizational objectives, which are gradually broken down into the individual processes (see Fig. 2).

Figure 2. Creating value of process



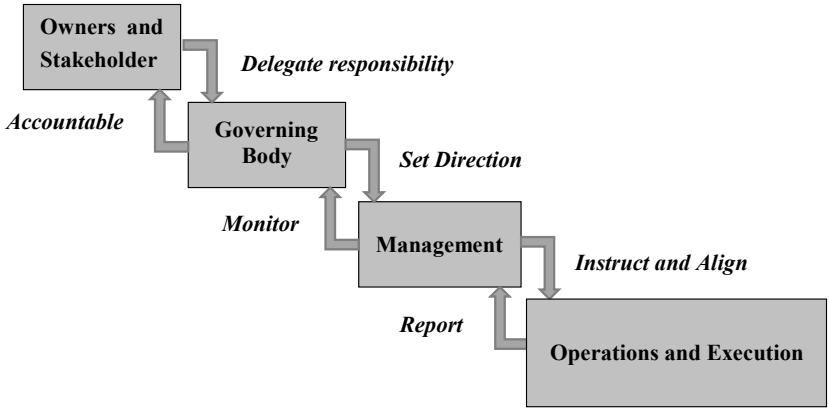
Source: own study based on (Bernard, 2012).

2.2. Principle 2: Covering the enterprise from end to ends

Within business process management we need to maintain the principle that the global optimum is not simply the sum of local optima (Vilamová et al., 2012). For this reason it is necessary to define the rules of the game (business governance), which will be valid for the company as a whole. This governance of the company must be defined as common to be able to:

- categorize the resources (enablers),
- define the scope,
- determine responsibilities (roles, activities and relationships).

Figure 3. Cascade of decay of requirements of processes to activities



Source: own study based on (Harmer, 2013).

When defining the responsibilities, everything begins from the stakeholders, especially the owners of the company. They must specify their requirements and delegate responsibility for creating governance to senior management of the company (Governing Body). But the company owners are not relieved of their responsibility, they maintain accountability. Senior management of the company set the direction which defines the role of middle management of the company. Middle manage-

ment (Management) instructs the executive branch (Operation and Execution). The executive branch must feedback by reporting the results of their management work, which is monitored by senior management. The whole scheme of relations and responsibilities can be seen in Figure 3.

2.3. Principle 3: Applying a single integrate framework

In IT, there are many recommendations, standards and various methodological frameworks. Each was created by a different organization using different terminology and has a different approach. Some of them complement each other and some overlap. The fact that each takes a different approach makes it difficult in practice to use. ISACA, COBIT as an author, therefore seeks to:

- *unify* the various methodological frameworks created in the past association ISACA (COBIT4, roll and RiskIT),
- *roof* methodological frameworks from other organizations. In developing COBIT®5 each framework was compared and analysed. In short you can say that COBIT®5 tells why and how they use the other frameworks.

2.4. Principle 4: Enabling a holistic approach

Smooth functioning of the company must be based on sound foundations, which in COBIT5, must be balanced in terms of the following seven pillars (Bernard, 2012):

1. *Principles, policies and frameworks*, which defines the rules for everyday work.
2. *Processes*, which define the activities to achieve the desired results and the individual interfaces (according to Doucek et al., 2008).
3. *Organizational structures*, which define the various ways people are organized.
4. *Culture, ethics and conduct*, which determines expected behavior and communication in the organization.
5. *Information*, which defines what information is formed, where this information is needed and how it is secured.
6. *Services, infrastructure and applications* that define the technical means necessary to ensure the logical interconnection of information.
7. *People, skills and competencies*, which determines current skill levels and needed skill levels in order to be able to meet the objectives.

COBIT®5 offers a systematic and structured way to define each of the following four pillars and their measurements (stakeholders, goals, lifecycle, good practices). The measurements of the individual dimensions can be viewed in two ways. We can ask:

- what is the extent to which we achieve the goals set,
- how much we manage to implement individual recommendations.

2.5. Principle 5: Separating governance from management

Every employee in the organization needs to know what their job is. Their supervisor must specify the task to motivate him and must check the result. There must be a unified leadership (governance) organization. It is necessary to distinguish between overall leadership (directing) and

daily management (Harmer, 2013). COBIT®5 highlights the difference between leadership and management. This distinction is reflected in the "Process for Governance of Enterprise IT" model when it is defined 37 processes and each of which is divided into next 5 domains:

1. Evaluate, direct and monitor,
2. Align, plain and organize,
3. Build, acquire and implement,
4. Deliver, service and support,
5. Monitor, Evaluate and assess.

"Evaluate, direct and monitor domain" is reserved only for processes designed to governance of organizations and the rest is intended for everyday driving.

3. Metrics of processes

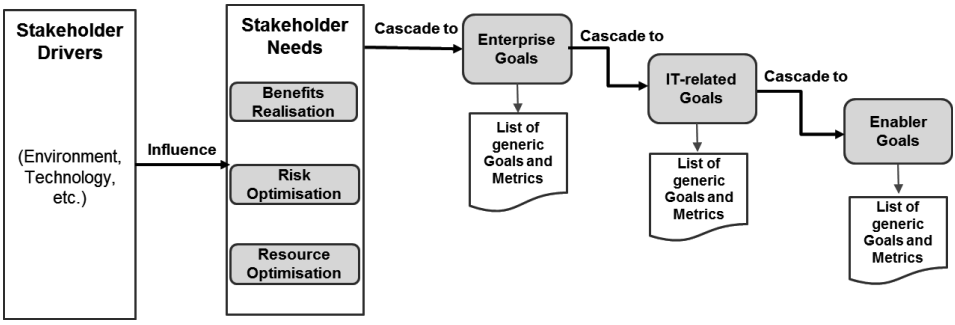
Metrics are defined by Učeň (2001) as "strict financial or non-financial indicators or evaluation criteria that are used to assess the level of effectiveness of specific areas of corporate performance" in which are defined basic attributes placed on metrics, which are: Metrics ID, name, owner, design, dimensions, and default values, target values, the data source for the measurement, the measurement and verification.

To determine the basic groups of indicators the parameters can be based on the natural triple imperative of project management, which include cost, quality and time, which is consistent with the achievement of competitiveness for each company (Grasseová et al., 2008).

3.1. COBIT5 goals cascade

The goals cascade is the mechanism that translates stakeholder concerns into tangible goals that can be managed in a more consistent manner can be seen in Figure 4. Goals cascade translates stakeholder needs into Enterprise goals, and then further down to IT-related goals, and finally to Enabler goals (processes, and process goals).

Figure 4. Goals cascade and lists of generic goals and metrics



Source: own study based on (Harmer, 2013).

Each level of goals cascade provides "List of generic Goals and Metrics" whose structure is based on the methodology of Balanced Scorecards structure (*Financial, Customer, Internal, and Learning and growth*). An example of enterprise goals metric can be seen in Table 1.

Table 1. Sample of enterprise goals metric divided by balanced scorecards structure

BSC Dimensions	Enterprise Goals	Metrics
Financial	*1. Compliance with external laws, and regulations* *(2. – 5.) ...*	• Cost of regulatory non-compliance, including settlements, and fines • Number of regulatory non-compliance issues causing public comment or negative publicity • Number of regulatory non-compliance issues relating to contractual agreements with business partners
Customer	*6. Customer-oriented service culture* *(7. – 10.) ...*	• Number of customer service disruptions due to it service-related incidents (reliability) • Percent of business stakeholders satisfied that customer service delivery meets agreed-upon levels • Number of customer complaints • Trend of customer satisfaction survey results
Internal	*(11. – 15.) ...*	...
Learning and growth	*(16. – 17.) ...*	...

Source: own compilation based on (Harmer, 2013).

4. Example of implementation

Based on the long time cooperation between the Faculty of Economics and ATTN Consulting company that deals with process performance measurement and strategic goals measurement was performed:

- Company ATTN adopted the principles COBIT5, which has incorporated into its software product.
- It was created a repository of metrics on the structure Goals Cascade.
- Created repository contains not only the metrics regarding IT, but also non-IT metrics in the structure of Balance Scorecards (BSC).
- Periodically evaluate the efficiency and suitability of implemented metrics in realized projects.

5. Conclusion

Enterprises respectively stakeholders have different priorities and goals that usually change over time. COBIT®5 greatly helps in determining the metrics of IT processes in all companies regardless of their size.

The use of goals cascade represent the way of determine common denominator which in general provides inter-relations of the different levels of goals. The goals cascade provides mapping tables between enterprise goals and IT-related goals and between IT-related goals and the framework

processes. It does not contain the ultimate and most complete answer. Users of the framework should not attempt to use it in a purely literal way, but rather as a guideline.

The foregoing principles can be generalized on all key business processes in companies.

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Chapter 25

EDI/XML Interface Modeling Problems – Polish Justice Administration Institutions Case Study[1]

Jan Trąbka

1. Introduction

Currently the implementation of Electronic Data Interchange (EDI) technology is becoming a strategic direction of IT development in business organizations and administration worldwide. EDI is defined as a data exchange process between the computer systems of individual organizations, crucial to their effective functioning, and which fulfills the following assumptions:

- the data transfer is held electronically through electronic documents (EDI messages),
- the data is stored according to standard format defining the syntax, structure and content,
- the data is generated and entered to the receiving computer system automatically without human intervention (Wojtachnik, 2004; Burczyński, 2011).

The first EDI technology implementations date back to the 1960s and the pioneering economy sectors where finances, logistics and transport (Kosmacz-Chodorowska, 2013; Tiwari et al., 2012). As the years went by, EDI has become one of the basic technologies used in such management methods as E-commerce, Supply Chain Management (SCM) or e-Government (Niedźwiedziński, 2004). It may be stated that currently EDI technologies are the object of interest of all organizations transferring between one another massive amounts of data, traditionally sent in the form of paper documents. These can be documents in electronic form, for example, document scans stored in PDF format, which still have to be manually entered to the receiving IT system – eliminating this process is EDI's key advantage. In order to show the extent of savings made thanks to the use of EDI, one may quote the calculations of multiple French FMCG branch companies showing annual savings of over €793 mln. The calculations indicate that savings for solely the ordering process may amount to as much as 87% (Kosmacz-Chodorowska, 2013).

The basic technical assumption of EDI is to create an interchangeable electronic documents format which allows for a seamless data exchange between the sender's and the receiver's systems. In order to implement EDI effectively its standards are defined by regional or branch standards setting organizations (Vries, 2013). Currently, the two best known standards in the world are

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the American ANSI ASC X12 and the international UN/EDIFACT used in Europe. Standards may also be tailored to meet the needs of specific branches, for example SWIFT in banking or ODETTE in the automotive industry.

The formal principles of standard messages format as well as the media via which they are sent have changed over the last several years. The authors (Dąbrowski, 2002; Tiwari et al., 2012) mention communication models such as traditional EDI (based on older EDIFACT standards and VAN type networks), Lite-EDI, Web-EDI or EDI/XML as well as the newest one, based on web services. The technological aspects of the above-mentioned models have been discussed in detail in (Dąbrowski, 2002; Gawin, 2015). The development of XML, which is a self-describing data format (Dąbrowski, 2002), has become a milestone in easier and cheaper, and thus more common, EDI technology implementation.

As far as EDI's widespread presence is concerned it should be noted that some specific inter-organizational processes have not developed their own branch standards yet or due to their nature and local character will always be implemented individually, directly between the partners. In this case it is necessary to perform a business analysis and design the processes and formats of EDI messages from scratch. Such a case analysis and the modeling tasks of the above-mentioned EDI-based communication aspects are the subject of this article. The aim of this paper is to examine the analytical tools available when implementing an EDI/XML-based communication. Two approaches were chosen to be compared. The first approach is based on the current standard of modeling information systems – the UML language. In point 2, the author has cited and discussed in particular the usage of the UML modeling language. The main thesis of this part of the paper is that this approach is correct from the technical point of view, nonetheless it is very difficult to be understood and used by people who are not IT experts. Hence in point 3 and 4 the second approach (proposed by the author) is presented. This approach is based on the BPMN standard and EDI-dedicated data dictionaries. Both of the author's tools proposed in this approach are dedicated to be used by an analytical team consisting of IT experts and business professionals. To verify the proposal introduced, the conclusion section (Point 5) describes the project of creating individual EDI-based communication between two Polish justice administration institutions: a district court and a police unit in the detainee escorting procedure.

2. EDI/XML-based communication modeling

2.1. The evolution of inter-organizational processes modeling approach

The development of EDI-related techniques made it necessary to search for inter-organizational processes modeling tools. At their core EDI technologies are based on standardization of communication between organizations. However, in each case both of the cooperating parties have to integrate the activities of sending and receiving EDI messages into the flow of their own internal business processes. There are also areas in organizations' activities which due to their nature, local or niche character have not been standardized yet, which is the subject of this article. In such situations the parties have to not only model the inter-organizational process but also make an extra effort to determine the structure and semantics of the data exchanged, to establish their own internal EDI-based messaging standard. In both of the cases it is strategically important to look at

the whole, two-sided inter-organizational process since only then is it possible to see the optimization possibilities to the parties' mutual advantage.

The history of inter-organizational process modeling and EDI-based communication is concurrent with the development of the methodologies used in the analysis and design of Information Systems (IS) and subsequently business processes modeling. The late 1990s papers on the inter-organizational processes modeling (Aalst, 1998; Aalst, 2000) used flow charts, Petri nets and sequence diagrams. The object-oriented approach (OO) in the analysis and design of IS and consequently publishing by the Object Management Group (OMG) the UML standard was also an important step in the development of EDI-based communication modeling techniques. The object-oriented idea of inter-organizational processes creation will be analyzed in the following subchapter. In the 1990s, while process management methods such as Business Process Reengineering (BPR) were being developed, modeling methodologies dedicated to business processes appeared (Marcinkowski & Gawin, 2015). The methodologies were, inter alia, IDEF and comprehensive methods assisted with IT tools such as ARIS (Gabryelczyk, 2006) or BPMS (Gawin & Marcinkowski, 2015). The use of the ARIS method in inter-organizational processes modeling was shown by Lin (Lin, 2008). This paper will demonstrate the application of Business Process Model and Notation (BPMN), the first processes modeling standard currently developed by OMG. The analysis of the advantages of BPMN application will be supported by comparing it to the aforementioned object-oriented approach.

When comparing modeling techniques it is advisable to set some key requirements for the situation examined. In our case it is the communication between two organizations using the EDI/XML-based technologies and not the internal structure of IT System that is being modeled. Huemer (1999), when describing problems connected with the organizational processes modeling, set the following requirements for the analytical techniques used (these requirements are also effective for EDI/XML-based communication):

- the boundaries of the inter-organizational business system must be well understood,
- the models must be able to capture the communication processes between the organizations. The order of the communication processes must be defined,
- the data structures supporting the information flows must be identified,
- the guidelines must support the modeling of different scenarios (including different information flows and different data structures) based on different situations (conditions) within the same business transaction,
- the sequence of the activities to be performed by each party in the business transaction should be clearly identified.

The EDI/XML technology's specific character and this paper's assumptions set one more important requirement for the modeling process. At the business analysis stage the EDI/XML-based communication model allows to omit the internal hardware and software aspects of the parties preparing themselves to implement joint communication. The key aim is to determine the communication process specification and the structure and semantics of the data exchanged in individual messages. In this task the main part will be played by business experts representing the cooperating companies therefore the requirement can be named "easy to use for non-IT users".

2.2. Object-oriented EDI modeling assessment

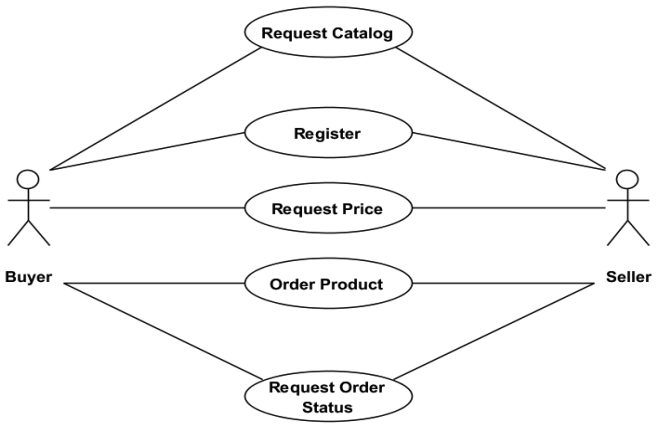
The official history of object-oriented approach to EDI modeling started in 1998 when the Techniques and Methodologies Working Group (TMWG) of UN/CEFACT decided to use UML as a tool for the UN/EDIFACT standard development (Rawlins & Chung, 1999). Before finally adopting the object-oriented approach, TMWG considered alternative tools such as IDEF and EXPRESS-G.

The paper will refer to the case analyses described by Huemer in his "Modeling Inter-organizational System with UML" (Huemer, 1999) and "Defining Electronic Data Interchange Transactions with UML" (Huemer, 2001). In the first article UML was used to present a part of the international trade transaction model (ITT). The part describes an exemplary set of transactions between the exporter, insurer, forwarder and carrier companies realizing the Preparation For Export process. The communication between Seller and Buyer in the set of transactions realized in the Order from Catalog main process was shown in the second of the above-mentioned essays.

UML is a set of graphical tools presenting a number of aspects of the system modeled. UML 2.0 published in 2003 contains 13 diagrams divided into two classes: structural and dynamic (Wrycza et al., 2005; Grabowski et al., 2014). To each of the cases described in both of Huemer's papers four basic diagrams were used: a use case diagram, an activity diagram, a sequence diagram (system dynamics) and a class diagram (system structure).

The use case diagram presents the interaction (messages exchange) between an actor or actors (system users) and the system itself as a sequence of simple steps. A use case diagram describes what a system (or a subsystem) does, however it does not specify the way it is done (Booch et al., 1998). Structurally, in its form the use case technique consists of a diagram showing what use cases function within the model boundaries and scenarios – a text tool describing each of the use cases in the following arrangement: aim, main and alternative scenarios, pre- and post-conditions and guarantees (Cockburn, 2001). Figure 1 presents a use case diagram in the Order from Catalog model. An important assumption of the presented approach is to treat the complete EDI-based communication between parties as an EDI system jointly used by the parties. Individual events taking place in order to close the business transaction are depicted as separate use cases.

Figure 1. Use Case Diagram "Order from Catalog"

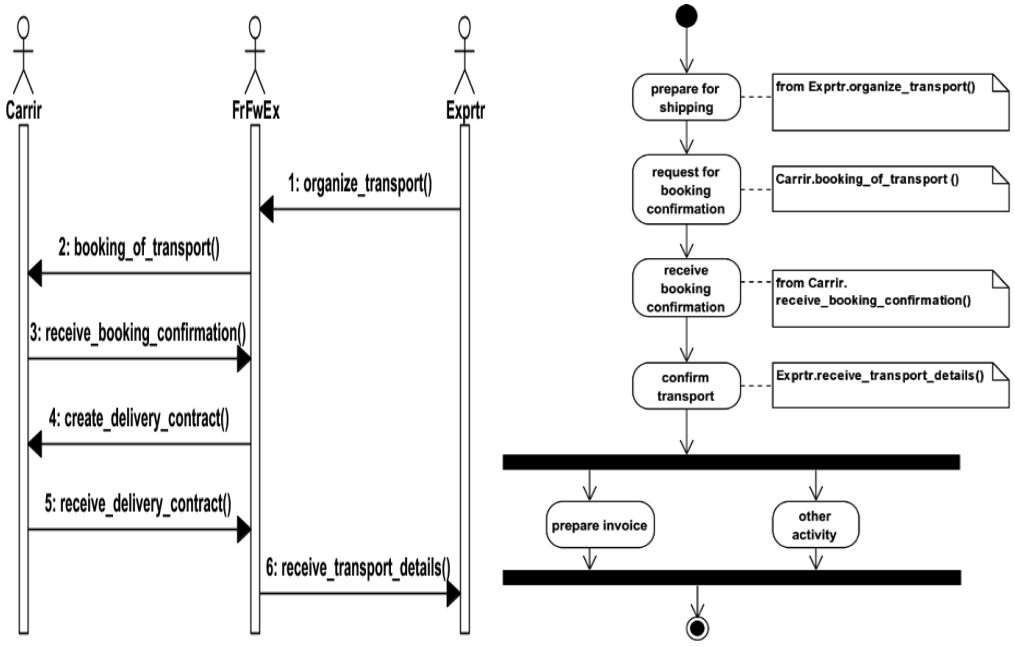


Source: (Huemer, 2001).

In the diagram above, we can see a buyer – seller communication, however, it does not show the detailed messages exchanged. The data exchanged and the alternative paths (as well as the other use case parameters) are specified in the scenarios of individual use cases (Huemer, 2001; Fig. 3).

The communication events between actors within individual use cases are depicted in sequence diagrams. A sequence diagram shows the interaction between groups of objects as a part of a use case (Fowler & Scott, 2000). An exemplary sequence diagram presented in the ITT model has been shown in Figure 2. The diagram depicts the interaction between the following actors: an Exporter (Exprtr for short), Freight Forwarder (FrFwEx) and Carrier (Carrir). The diagram is adjusted to the EDI service model where information systems make particular services accessible and call them mutually. The attributes of the called services may take form of data sets sent between systems (e.g. in form of XML-based messages). In the sequence diagram we can see what communicates/ services will flow/will be called. However, the lack of information on the precise communication schedule is the diagram's drawback.

Figure 2. Preparation for Export ITT sequence diagram on the left. Forwarder (FrFwEx) activity diagram (excerpt) in the Organize Transport use case on the right



Source: (Huemer, 2001).

The next aspect necessary in the EDI-based communication model is the internal activities of the communication participants with an indication of these which will require sending a message or will expect to receive one. Activity diagram is a UML tool which allows us to show a sequence of actions realized by an actor as a single use case is realized. The diagram is used in business analysis in a wider context as a tool presenting the steps of the whole process realized by an actor

(an organization or a unit). Figure 2 (right part) presents the activities performed by the Forwarder when realizing the Organize Transport use case. The activity diagram shows all activities necessary to realize the use case's aim (not only those connected with communication) – which fulfills the requirement of correlating EDI-based communication with the partners' internal processes. The disadvantage here is the lack of a precise image of the process's asynchronous nature and the resulting delays.

The last aspect modeled is the data structure. Here one of the basic UML structure diagrams, namely the class diagram was used. According to the object-oriented approach when describing an object we define its characteristic attributes and methods that allow other objects to enter and change the attributes. The class diagram is used to define the structure of object-oriented or relational databases. For this reason the notation itself is complex and thus inaccessible to non-IT users. The aforementioned use case "Register Buyer" class diagram may serve here as an example (Huemer, 2001; Fig. 5). It contains as many as 15 classes, a number of attributes and relations. The author of the model presents the whole structure of source classes together with their methods and adds a set of interface classes responsible for the coordination of EDI transmission. However, in the EDI/XML modeling it is assumed that the parties' IT systems are hermetic, i.e. only the sort of messages (documents) that are to be exchanged between the parties is defined. Single messages are not complex data structures so in their case the class diagram is unnecessarily complicated.

To recapitulate, UML is an efficient communication modeling tool between IT systems in the traditional/service-oriented EDI model, however, employing the EDI/XML-based model has a few drawbacks:

- four separate and complex notations have to be used, consequently the requirement of "being friendly for non-IT users" is not met,
- the class diagram is too complex for simple EDI message structures, at the same time it omits the business significance of the individual data elements (which need to be jointly defined at the business analysis stage),
- none of the tools used provides a clear view of the data flow schedule.

3. BPMN in EDI/XML-based communication modeling

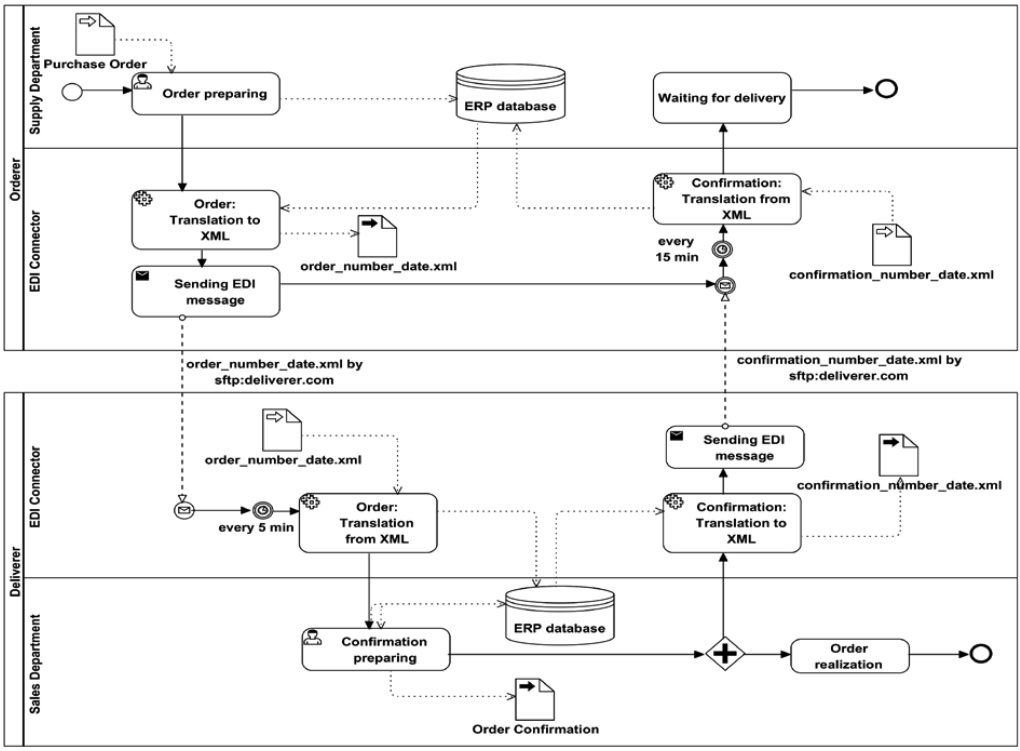
BPMN is a concept model and graphical notation for business processes presentation. The main assumption of the BPMN creators was to provide businesses with the capability of understanding their internal business procedures in a graphical notation and give organizations the ability to communicate these procedures in a standard manner. Furthermore, the graphical notation was supposed to facilitate the understanding of the performance collaborations and business transactions between the organizations (OMG, 2016). That BPMN has become a standard may be supported by the fact that in 2013 the International Standard Organization announced BPMN 2.0 an ISO/IEC 19510:2013 norm (ISO, 2013). We shall also verify the opinion in this article by comparing the UML usability with the BPMN notation in the context of EDI/XML-based communication. The BPMN standard is designed to be interoperable and executable and comply with the Service Oriented Architecture (SOA). Consequently, the document standard (currently version 2.0 published in 2011) (OMG, 2011) contains a description of how to transfer the diagram's graphical elements with their attributes to the Business Process Execution Language (BPEL). BPMN is a notation

which allows to model the collaboration, i.e. the processes of co-operation of two 'independent users', e.g. companies collaborating in a supply chain.

The basic tool of BPMN notation is the Business Process Diagram (BPD). As will be presented further in the paper it fulfills the following functions: it shows the sequence of activities realized in a process, the data (resources) used in each of the activities, alternative ways of process flow and, what is important in B2B processes – the communication between the process's participants. The BPMN standard defines the notion of an internal – private process as a process performed inside of a particular organizational unit. The other type is a public process used to model the interaction of a private process with another process or participant. It is the public processes that constitute the structure dedicated to EDI/XML-based communication modeling.

Figure 3 shows the Order Delivery process diagram realized by an Orderer and a Deliverer. The process respects the EDI/XML-based communication model. Each of the participants is presented in a separate pool (original naming). Each of the pools may contain roles. In our example we can see two roles in the Orderer's organization: the Supply Department and EDI Connector – an IT system realizing the document translation tasks from the ERP system data structure to an XML-based message in the format previously agreed on between the parties. On the Deliverer's side we can also see an EDI Connector and the Sales Department which gets an order, confirms it and starts its realization. The activities realized by the particular roles (rounded rectangles) have additional stereotypes determining whether the task is realized by a human aided by a computer system or entirely automatically. Within the pool the activities are connected with sequential flow, showing the process's control. All that can occur between the pools, which are independent participants, is the flow of messages. This assumption (often difficult to grasp for new BPMN users) is natural and comprehensible in the examined EDI/XML-based process model. A participant sending an EDI message and expecting its confirmation cannot manage the process realized on the other side of the B2B process. However, this does not mean that a common perspective on the collaboration processes is completely unnecessary at the stage of analysis and implementation of EDI/XML-based communication. As has been presented BPMN is a remarkably transparent tool for such purposes. A thorough examination of the BPMN 2.0 specification may suggest that public processes should present only the activities of message sending/receiving but according to many authors this substantially lowers the analytical value of such an approach (Drejewicz, 2012). The BPMN diagram (Fig. 3) shows also the time events (circles with a clock symbol) which are supposed to show the time aspect (delays in the process). This aspect has not been depicted on the UML diagrams.

Figure 3. Typical B2B – Order Delivery Process used EDI/XML communication model. BPMN notation



Source: own elaboration.

To sum up, BPMN enables us to model EDI-based communication on one diagram whereas using UML we would need three: a use case, an activity and a sequence diagram. Each of the just mentioned had a completely different notation set and structuring. BPMN allowed us to create a single simple "non-IT" notation diagram. Simultaneously, we were able to easily convey additional information, e.g. time aspects of the EDI-based communication process. Bearing in mind the potential of translating BPMN to WS-BPEL at this point of the analysis we could start to build a communication model based on the Service-Oriented Architecture.

4. The author's proposal – Data Dictionary for EDI/XML-based communication

The BPMN diagram shows activities realized by the EDI process participants, the messages sent, time aspect and transmission protocols. However, it does not specify the data the messages hold, their format and the EDI/XML document's internal structure. The aspect of content, format and structure of individual documents is particularly important in situations when we cannot rely on defined EDI standards. At the time it is a joint team of both of the companies implementing

EDI-based communication, consisting of business users and analysts, who have to create their own internal standard for particular kinds of EDI transactions. This stage should begin with determining the data that will be exchanged and the unambiguous business context. Subsequently its detailed formats should be defined. XML documents may have internal hierarchical structure (for instance, an order consists of a shared header and many interconnected lines, see the Example), however, they are not as complex as to use tools such as UMLs class diagram. For this reason, this section of the article will present an analytical tool already known in its original version from structural approaches, namely the data dictionary (DD) (Yourdon, 1988). DD will be adjusted to the notation requirements and the process of EDI documents processing in XML (short EDI_DD). XML is a language used to create documents which enables placing directly, within the electronic document, a description of its structure and semantics of the particular pieces of information. The example below presents an excerpt of an order document.

```
<order>
 <header>
      <orderer_name>ABC Corporation</orderer_name>
      <order_date>2016-06-01</order_date>
 </header>
 <items>
      <item>
           <name>Apple</name>
           <quantity>15</quantity>
      </item>
 </items >
</order>
```

XML is a tag-based language – tags carry additional description of the data contained in the document (so called metadata). This makes an XML document legible and easy to interpret, both for a human (programmer) and a computer system. Additional data characteristics, i.e. data type, count or whether it is required or not, may be placed in the document itself or more often in separate XML files, so called schema documents. These are special types of documents and their notations – the older Document Type Definition (DTD) and the currently more and more frequently used XML schema. The schemas contain data formats as well as configuration information for XML parsers. Parsers validate the document according to the XML semantics as well as the schemas describing the basic document. Upon the document's validation parsers allow, for example, to generate a data presentation layer in HTML and in the case of EDI to fill in the database (e.g. ERP systems) with the content of the processed XML document. XML consists of controlling tags defined in the basic syntax of the language and user-defined data description tags dependent on the aim of the solution being implemented. Accordingly, the task for the analytical team is to define the structure of the document, the tag names (with the context they appear in for unambiguous understanding) and formats allowed for the particular data.

Even though an XML document can be interpreted, often intuitively, by a human, it is an electronic document which means it is created and read by a computer system. Business users do not have to be acquainted with the principles of such a document creation or the XML notation details. The paper offers them a data dictionary in the form of a table. A dictionary for the result XML file from the example above is presented in Table 1. In an XML document elements are the basic

information carrier. The elements defining single data follow the pattern <tag>content</tag> (for example, <order_date>2016-06-01</order_date>). An element can also build the structure which means it does not contain any elementary data but consists of a set of subordinate elements (for example, <order> <header>..<items>.. </order>). This characteristics enables the creation of the hierarchical XML document structure, which is also taken into account in the dictionary presented. The EDI_DD dictionary contains respectively:

- element name (i.e. tag),
- upper (parent) element – which indicates the element that the tag is assigned to according to the structure. This section of the dictionary provides control of elements assignment,
- description – the element's business context. This section of the dictionary helps understand what particular data is in a business context,
- definition – for structure elements, it shows which subordinate elements make up the main element. It allows tags, e.g. {} – multiplicity or () – optionality, regularly described in structural data dictionaries (Yourdon, 1988),
- type – defining the XML type of the element's content,
- min and max occurs – the values allowed, e.g. the number of characters or structural elements,
- use required – whether it is required or not.

The dictionary is supposed to provide the basis for creating an XML document schema. EDI_DD, being a supplementation of the BPMN notation process model, will form a complete set of analytical documents serving the implementation teams to prepare (now separately) the IT environments for the introduction of EDI-based communication.

Table 1. Example of EDI data dictionary for Order document (in non-alphabetical order)

element name	upper element	description	definition	type	min occurs	max occurs	use required (Y/N)
order		*document type order*	header+items				Y
header	order	*order header*	orderer_name + order_date				Y
orderer_ name	header	*orderer full name*		string	1	255	Y
order_ date	header	*date of order*		date			Y
items	order	*order lines*	{item}		1	10	Y
item	items	*single item*	name+quantity				Y
name	item	*product name*		string	1	25	Y
quantity	item	*number of*		integer			Y

Source: own work.

5. Case study – Digital writ of habeas corpus

5.1. Project background

A Digital writ of habeas corpus (D-writ for short) is an Electronic Data Interchange solution facilitating the transmission of court orders to bring prisoner(s) and/or witness(es) to the court room, between courts and police units (it replaces paper communication with an EDI-based communication channel embedded in the interested parties' computer systems). The solution uses an XML-based EDI protocol and encrypted channel (Grabowski et al., 2014) and was prepared within the project "Education in the area of time management and cost management of judicial proceedings – case management". The project was one of the initiatives towards the improvement of Polish judiciary through increasing the operational effectiveness of the Polish common courts, obtaining cost efficiencies and upgrading professional qualifications of their employees. The financial resources for the project[2] implementation were granted to the Ministry of Justice and its subordinate units from the European Social Fund within the framework of Human Capital Program (2007-2013). The project was coordinated by the National School of Judiciary and Public Prosecution.

One of the main goals of the project was to prepare and implement 20 good practices in the area of management and IT in a pilot group consisting of 30 selected law courts. The responsibility for the practices preparation was put on a team of 8 experts, Cracow University of Economics academic workers. The author of this paper was one of the team members and was in charge of the creation of 6 of the practices in the field of IT/IS. One of them is the Digital writ of habeas corpus.

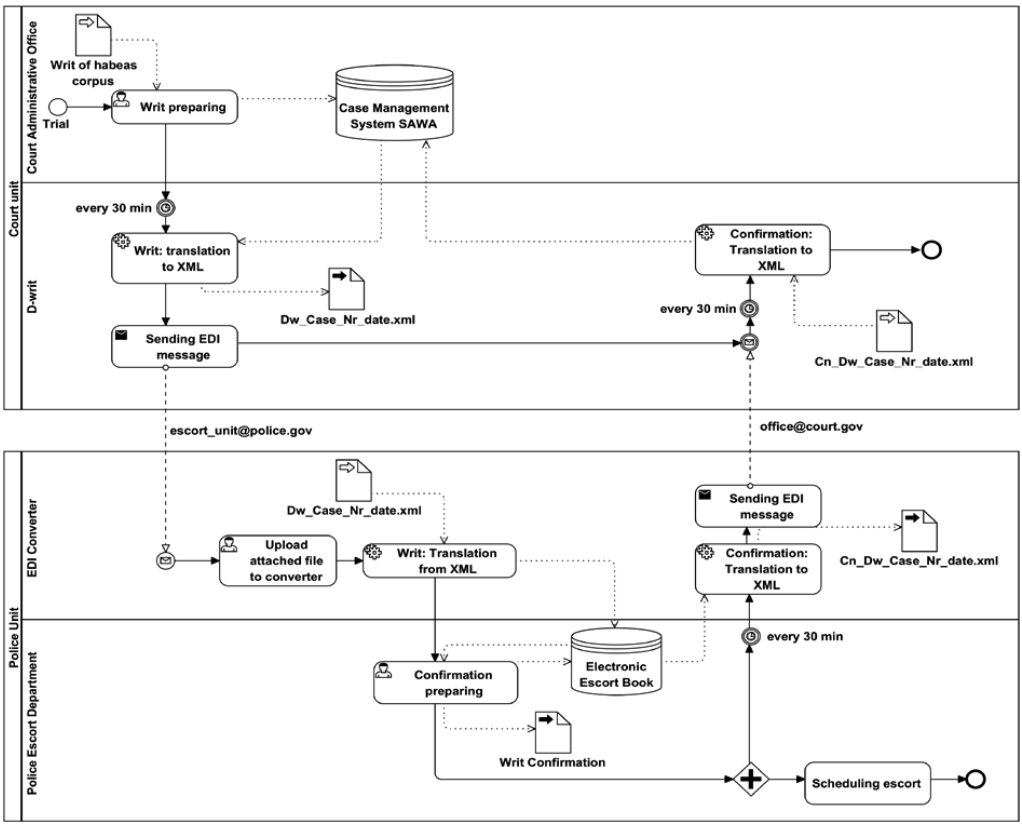
5.2. Solution modeling

In most of the pilot law courts the process of escorting the detained prisoner or witness from prison to court room was realized by delegated police escort units. The process started with the judge setting the trial date and sending the escorting unit a notice of the necessity of an escort, a so called writ of habeas corpus. The writ was generated by the court Case Management Systems (SAWA), signed by the judge presiding and sent as a traditional registered letter. Upon receiving the writ, the police escort unit entered it to its own system, so called Electronic Escort Book. The next step was to prepare a confirmation, which was sent back to the court unit. The law courts also noted the fact of receiving the letter. The complete information flow in this course took 1-2 weeks. The costs of the process realization also posed a problem – appropriate calculations have been included in the paper's conclusion. Within the framework of the IT/IS good practices development project a team consisting of experts and Administration workers as well as an IT Department of one of the courts, the good practice initiator, an analysis was carried out concerning an alternative method for the process based on the EDI/XML model. The process in its optimized version is depicted in Figure 4. The model uses the BPMN notation described in the previous chapter. When modeling and verifying the optimized process version a problem of legislative sort appeared. Namely, the writ had to be hand signed by a judge or an authorized worker of the Court Administrative Office. A certified electronic signature was considered, however, it would also have

[2] Project 'Education in the area of time management and cost management of judicial proceedings – case management' agreement for subsidizing the project (POKL.05.03.00-00-012/11) concluded on 13 July 2012, end-date on 31 July 2014, total amount of grant amounting to PLN 3,726,600.

to be legally permitted. Finally, the Minister's of Justice amendment to administrative proceedings was applied, which allowed to use and pass writ type documents entirely electronically.

Figure 4. D-writ Process used EDI/XML communication model. BPMN notation



Source: own elaboration.

Next, in collaboration with a police IT team a data dictionary for the required EDI-based messages (writ and confirmation) was created. An excerpt of the dictionary can be found in Table 2. The next step, already on the implementation level, was to prepare EDI translators responsible for reading the data from its source systems and transforming it into the agreed EDI/XML format. This task was performed independently by both of the process parties' IT teams. The tool created by the court IT Department was called D-writ (formal Polish name e-nakaz). The first versions of the solution used internal electronic mail system encrypted with GPG software for the communication protocol. Ultimately, SFTP protocols will be used.

Table 2. EDI Data Dictionary D-writ excerpt

element name	upper element	description	definition	type	min occurs	max occurs	use required (Y/N)
writ		*document type writ -core*	case-number + doc-date + court-unit-name + trial-date + appearer – status				Y
case-number	writ	*case number*		string	1	100	Y
doc-date	writ	*issued on*		date			Y
court-unit-name	writ	*court unit*		string	1	255	Y
trial-date	writ	*trial (escort) date*		date	1	10	Y
appearer-status	writ	*appearer status (accused/ witness)*		list			Y

Source: own work.

6. Conclusion

The aim of the paper was to present a transparent and legible for business users set of tools needed to model EDI-based communication using XML. The recommended tool set is based on the BPMN notation and the author's proposal of a data dictionary dedicated to EDI/XML communication. The case study has shown the comprehensibility and efficacy of the above-mentioned tools. It is worth noticing that the description of good practices had to comply with the requirement of completeness and clarity as it constituted the basis for the implementation of the proposed solutions in the whole pilot group and ultimately in all Polish courts.

To sum up, the benefits of the Digital writ of habeas corpus implementation as an application of EDI technology in the state's administrative bodies, one may quote the estimated savings calculated for the area of territorial jurisdiction of a court which first implemented the D-writ. In its territory there are 30 000 writs sent a year. After implementing EDI-based communication 2 500 man-hours were saved as well as PLN 130 000/€ 32 000 (the cost of materials and mailing services). The calculations do not include the savings made by the other party to the process – the police units, where the extent of savings will be similar.

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Chapter 26

Supporting Healthcare of the Elderly through ICT: Socio-demographic Conditions and Digital Inclusion[1]

Ewa Soja

1. Introduction

The contemporary changes in demographic phenomena in developed countries result in deepening of the process of population ageing. This will result in a continuous increase in the share of older people in the population structure (e.g. Coleman, 2001). Among various consequences of these changes researchers point to the growing financial costs for the health protection system and social support for the older people (e.g. Wilk et al., 2013; Tabata, 2005). The important issue is also related to informal assistance addressed to elderly people requiring care, which is particularly prevalent in post-transitional countries (e.g. Rosochacka-Gmitrzak & Racław, 2015).

Information and communication technology (ICT) is a critical component of the contemporary world, offering a wide range of potential benefits in the field of healthcare. However, these benefits can be effectively used by society if digital inclusion is being promoted and the market of ICT services for an ageing society is functioning (e.g. Soja & Soja, 2015b; Porcari et al., 2015).

The general goal of this paper is to investigate the possibility of using ICT for the elderly healthcare in the context of socio-demographic situation and development of digital inclusion in Poland and other European countries.

This paper starts with the discussion of the condition of health and social care of the elderly in the context of ageing populations in Europe. Then, it examines the level of digital engagement at the individual level in European countries. The next section includes discussion of findings and explains implications for research. Finally, the article ends with concluding remarks.

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2. Health and Social Care of the Elderly in the Context of Ageing Populations in Europe

Nowadays, population ageing, defined as an increase in the share of the older people in the population, is a typical phenomenon of developed countries. Demographers claim that population ageing is inevitable and will deepen in the future. In consequence, the distribution of population by age group will change. According to demographic projections the percentage of people at post-working age will increase and the percentage of the population in the pre-working and working age will decrease. Demographers indicate that decrease in fertility and falling mortality are the main determinants of population ageing. However, in populations with low mortality, ageing results from a lengthened life span, rather than from the decline in fertility (e.g. Kurkiewicz, 2012; Coleman, 2001).

Europe is not homogenous in relation to demographic ageing. To illustrate this situation we show in Table 1 the basic measure such as the percentage of population aged over 65. We divide countries into two groups: post-transitional countries (including countries from the Central and Eastern Europe (CEE) region) and countries from the region of Northern, Western and Southern Europe (NWSE). The share of older people (aged 65+) in the whole population in the selected countries varies, both in the CEE region and in the NWSE area. Among the countries with the highest percentage of people aged 65 years and more, there are countries from both regions, i.e. NWSE and CEE. The same regularity occurs in the case of the lowest shares of the elderly. The value of shares above the third quartile (19.4%) can be observed for example in Italy, Germany, Greece and Bulgaria, while Poland, Slovakia, Ireland and Norway belong to countries whose percentages of population aged over 65 are lower than the first quartile (17.7%). However, demographic projections indicate that CEE will form the oldest part of Europe in the second half of the 21st century (e.g. Soja & Stonawski, 2007; Basten et al., 2013).

To describe the health condition of the European countries we apply two basic measures: life expectancy at birth and healthy life expectancy at age 65 years, which are especially important in the context of differentiation of mortality at advanced ages. In the case of life expectancy at birth, the main determinant of population ageing in developed countries, we observe the division between the CEE and NWSE countries. All NWSE countries and only Czech Republic and Slovenia from the CEE region have a life expectancy at birth above the first quartile (74.7 for males and 81.7 for females). In Poland, the value of life expectancy at birth is the highest among the rest of CEE. It should be noted that long-term positive trends in mortality demonstrated by the extended life expectancy have occurred in both groups of countries. However, in the group of NWSE countries, the increase was significantly greater and have occurred since 1960. In the CEE region a considerable improvement have occurred as late as after 1990. The extended life expectancy in the group of NWSE countries was also accompanied by the convergence of mortality. Changes in mortality measured by life expectancy at birth were connected with the reduced mortality in all age groups, and especially in the case of the youngest ones. In the group of CEE countries, long-term increase in life expectancy was associated with the divergence of mortality. A weaker increase in life expectancy in relation to NWSE countries was the result of the simultaneous negative changes in mortality among older age groups, especially after 1990 in the USSR and its successor states (e.g. Soja, 2013; Soja, 2012).

In most of the CEE countries we can notice that healthy life expectancy at age 65 years is lower than the first quartile (6.8 for males and 6.1 for females). The exceptions are Poland, the Czech

Republic, Bulgaria and Slovenia, where those values are slightly higher. However, as compared to the leaders (e.g. Iceland for males, Sweden for females), health situation of the elderly in Poland is much worse. For the older men in Poland, life span in a healthy condition is shorter by 7.9 years and for women shorter by 8.1 years respectively. We can say that the distance to catch up by elderly in Poland, as compared to the leaders, is greater than the actual length of years lived in good health for the older people in Poland.

The similar results, i.e. generally better health condition of the elderly in WNSE compared to CEE, can be noticed also in studies at the micro-level that used data from the SHARE project (Survey of Health, Ageing and Retirement in Europe). The health status was measured by the presence or lack of difficulties with activities of daily living. The lowest percentages of people with difficulties in daily life was observed in Germany (16.1%) and in the Netherlands (16.8%), and the highest in Poland (33.2%) and Hungary (30.1%) (Kurkiewicz & Soja, 2015).

Ageing of the population is associated with an increase in the share of the elderly and thus with more people in poorer health. In this situation, it becomes necessary to ensure appropriate conditions for social and health services for the older people. These conditions are described by the following measures: number of practicing physicians per 100 thousand inhabitants, number of curative care beds in hospitals per 100 thousand inhabitants, amount of social benefits per capita for sickness or health care (in PPS) and amount of social benefits per capita for old age (in PPS). In the case of the last measure, the expenditures cover care allowance, accommodation, and assistance in carrying out daily tasks.

Taking into account the number of doctors, the situation in both regions varies. For example, in Poland, Slovenia but also in Ireland we observe less than 295 doctors per 100 thousand inhabitants (the value of the first quartile), while in Norway, Germany, Bulgaria and Lithuania we notice stated over 390 doctors (the value of the third quartile). The second measure is defined as the number of all hospital beds, which are regularly maintained and staffed and immediately available for the care of admitted patients in all public and private hospitals. Only in CEE are observed the numbers of available hospital beds per 100 thousand inhabitants higher than the third quartile (429), while only in NWSE those numbers are lower than the first quartile (255). In the case of amounts of the social benefits intended for sickness or healthcare we can notice striking differences between the European regions. The highest level of spending, above the third quartile (2,505 PPS) is only in countries NWSE, and the lowest, below the first quartile (1012 PPS), only in CEE. The same regularity can be observed for the expenditures intended for older people.

Kurkiewicz and Soja, analyzing the European countries at the micro level using SHARE database, found that generally informal support for the elderly people with difficulties in daily life from outside the household in most NWSE countries is higher than in the CEE region. This can be explained to some extent by the fact that older people in the post-transtional countries are often living together with spouses and with other people, from which they can receive support (Kurkiewicz & Soja, 2015).

Table 1. Selected Indicators Describing the Conditions of the Health Situation in European Countries

	Social benefits per capita for sickness/health care in PPS	Social benefits per capita for old age (in PPS)	Curative care beds in hospitals (per 100 thou. inhabitants)	Practicing physicians (per 100 thou. inhabitants)	Healthy life years and life expectancy at age 65 – males	Healthy life years and life expectancy at age 65 – females	Life expectancy – males	Life expectancy – females	Population aged over 65 (%)
	2012	**2012**	**2013**	**2013**	**2014**	**2014**	**2014**	**2014**	**2015**
EU (28 countr.)	2 124,6	2 924	355,24		8.6	8.6	78.1	83.6	18.9
Northern, Western and Southern, Europe (NWSE)									
Austria	2 502,4	4 289,3	535,1		8.4	7.7	79.2	84	18.5
Belgium	2 545,7	2 882,2	395,49	295,1	11	11	78.8	83.9	18
Cyprus	1 060,5	2 253,9	320,09	322,2	10.4	8.8	80.9	84.7	21.7
Denmark	2 109,0	3 673,0	246,61		11	12.8	78.7	82.8	18.6
Finland	2 228,9	3 327,2	280,62	301,7	8.8	9.3	78.4	84.1	19.9
France	2 620,0	3 645,2	334,82	309,7	10.4	10.7	79.5	86	18.4
Germany	3 148,9	3 086,8	529,05	401,7	6.8	6.7	78.7	83.6	21
Greece	1 270,5	3 041,5			7.7	7.1	78.9	84.1	20.9
Iceland	2 512,6	1 748,6	226,4	362,3	15.4	15.1	81.3	84.5	13.5
Ireland	2 235,0	1 843,2	210,64	268,9	11.4	12.3	79.3	83.5	13
Italy	1 795,1	3 755,9		390	7.8	7.3	80.7	85.6	18.8
Netherlands	3 565,5	3 713,2			10.7	10.2	80	83.5	17.8
Norway	3322	3 643,4	229,23	430,6	15.3	15.9	80.1	84.2	16
Portugal	1 256,5	2 374,8	284,27		6.9	5.6	78	84.4	20.3
Spain	1 543,6	2 128,2	228,29	381,1	10.1	9.4	80.4	86.2	18.5
Sweden	2 408,5	3 943,4	193,97		15.2	16.7	80.4	84.2	19.6
Switzerland	2 766,5	4110	291,02	404	10.6	9.6	81.1	85.4	16.1
UK	2 358,2	3 269,0	227,92	277,1	9.7	10.6	79.5	83.2	17.7
Post-transitional countries (CEE)									
Bulgaria	538,1	911,5	524,25	397,7	8.7	9.6	71.1	78	20
Croatia	1 106,9	896,5	356,66	303,4	6	5.8	74.7	81	
Czech Rep.	1 375,3	2 002,6	436,88		8.5	9.3	75.8	82	17.8
Estonia	830,6	1 296,1	337,18	328,3	4.9	6	72.4	82	18.8
Hungary	899,7	1 747,3	399,34	320,9	6	6.1	72.3	79	17.9
Latvia	501,0	1 246,5	350,43	319,1	4	4.6	69.1	79	14.6
Lithuania	809,2	1 292,9	530,21	427,7	6.1	6.1	69.2	80.1	19.4
Poland	**802,9**	**1 648,2**	**430,66**	**224,1**	**7.5**	**8.1**	**73.7**	**82**	**15.4**
Romania	581,9	1 085,4	450,49	264,4	5.9	5.7	71.4	79	17
Slovakia	1 107,7	1 414,9	423,84	:	4.3	3.6	73.3	81	14
Slovenia	1 659,4	2 084,0	358,94	262,9	7.8	8.6	78.2	84	17.9

Source: own elaboration based on Eurostat database.

3. Using of ICT by Individuals in European Countries

Table 2 shows basic indicators of digital inclusion in European countries in 2015. They relate to Internet access at home by households and using the Internet by individuals aged 16 to 74. We notice that the best digital inclusion in terms of access to the Internet and its regular use is in the countries of Northern and Western Europe (Norway, Netherlands, Denmark, Sweden, United Kingdom, Germany, and Finland) and in Estonia, the only country from CEE region. For all these countries the shares of households with Internet access at home are higher than 89.5% (third quartile) and the shares of individuals regularly using the Internet exceed the value of the third quartile (85.5%). The exception is Germany, where the percentage is slightly lower (84%). In these countries the shares of people having never used the Internet are also lowest.

Table 2. Selected Indicators of Digital Inclusion in European Countries in 2015

	Households with Internet access at home (%)	**Individuals regularly using the Internet (%)**	**Individuals never having used the Internet (%)**	**Individuals using the Internet for interaction with public authorities (%)**	**Individuals using the Internet for seeking health information (%)**	**Individuals using the Internet for Internet banking (%)**
EU (28 countr.)	83	76	16	46	46	46
Northern, Western and Southern Europe (NWSE)						
Austria	82	81	13	57	54	51
Belgium	82	83	13	52	47	62
Cyprus	71	70	26	34	50	20
Denmark	92	93	3	88	66	85
Finland	90	91	5	80	67	86
France	83	81	11	63	40	58
Germany	90	84	10	53	62	51
Greece	68	63	30	46	37	14
Hungary	76	72	21	42	53	34
Ireland	85	78	16	50	35	51
Italy	75	63	28	24	30	28
Netherlands	96	91	4	75	61	85
Norway	97	96	1	81	64	90
Portugal	70	65	28	43	47	28
Spain	79	75	19	49	52	39
Sweden	91	89	5	73	52	80
UK	91	90	6	49	53	58
Post-transitional countries (CEE)						
Bulgaria	59	55	35	18	28	5
Croatia	77	66	26	35	50	33
Czech Rep.	79	77	13	32	40	48
Estonia	88	86	9	81	55	81

Latvia	76	75	18	52	41	64
Lithuania	68	69	25	44	46	50
Poland	76	65	27	27	28	31
Romania	68	52	32	11	27	5
Slovakia	79	74	16	51	47	37
Slovenia	78	71	22	45	47	34

Source: own elaboration based on Eurostat database.

Less favorable situation occurs in the post-transitional countries, especially in Bulgaria, Romania, Poland, Croatia and Lithuania, and in southern Europe in Portugal, Greece and Italy. In these countries only at most 86% of households (third quartile) possess access to the Internet, and at most 66.8% of people (third quartile) regularly use the internet. A slightly larger share of users is in Lithuania (69%). At the same time, at least 26% of people in these countries have never used the Internet.

Differences between countries are small when we consider the following forms of using the Internet: using the Internet for interaction with public authorities, using the Internet for seeking health information and using the Internet for Internet banking. The leaders are still Norway, Netherlands, Denmark, Sweden, Finland and Estonia. On the other hand, the Czech Republic, Poland, Romania and Bulgaria are the countries where people use the Internet for all indicated activity to the smallest extent. However, it should be noticed that in the case of using the Internet for interaction with public authorities we are seeing very little interest also in Italy. Equally little interest in using the Internet for seeking health information and in using the Internet for Internet banking we observe in Italy, France, Ireland and Greece.

The research at the micro level shows that in Poland in 2015 there was 60 percent of Internet users aged 45-59 years, 41 per cent aged 60-64 and 18 percent aged 65 or more. The study also revealed that the forms of the use of the Internet are varied due to age. The younger use the Internet more extensively. The Internet is for them a frequent source of entertainment. The older, on the other hand, rarely communicate via the Internet. Their basic use of the Internet involves access to information (Batorski, 2015).

Table 3 demonstrates reasons for not having Internet access at home in European countries in 2015. The displayed values indicate the shares of households with at least one member aged 16 to 74 and without Internet access at home because of selected reasons. In the case of reasons related to costs and lack of need for the Internet use, a diversity between the two examined country groups (NWSE and CEE) can be observed.

When we take into consideration the cost-related issues, Poland ranks below the average. In the case of motivations, in turn, Poland is placed above the average. Households revealing concerns for privacy and security form a significant share of the population only in Germany, Finland, the Netherlands, France, and Hungary. Countries with the smallest percentage of households disclosing concerns for privacy and security (less than 3%) also possess the smallest shares of regular Internet users. Estonia is an exception in this group as it belongs to the leaders when percentage of Internet users is considered. Countries with the smallest shares of households not having Internet access at home because of the lack of skills are leaders when a regular Internet use is considered. In the case of the greatest shares of households not using the Internet because of the lack of skills the situation is opposite. It should be emphasized that the most frequently declared reasons for not having Internet access at home in this case are lack of needs and lack of skills.

Table 3. Reasons for Not Having Internet Access at Home in European Countries in 2015

	Access costs are too high (telephone, etc.) (%)	Access not needed (content is not useful, not interesting, etc.) (%)	Privacy or security concerns (%)	Lack of skills (%)
EU (28 countr.)	23	46	9	41
Northern, Western and Southern Europe (NWSE)				
Belgium	19	44	8	31
Netherlands	17	64	25	33
Austria	9	78	9	21
Denmark	8	32	6	25
Germany	26	58	26	33
Finland	22	75	25	56
Ireland	13	43	4	44
Greece	12	26	3	61
Spain	27	66	3	40
France	29	25	20	28
Sweden	14	49	5	23
Italy	14	25	3	46
UK	16	43	5	26
Norway	8	26	13	11
Post-transitional countries (CEE)				
Bulgaria	24	44	1	52
Czech Rep.	20	69	4	39
Latvia	16	51	0	34
Lithuania	24	67	1	34
Hungary	50	68	19	62
Estonia	14	70	3	26
Poland	19	63	3	50
Croatia	39	69	14	41
Romania	24	38	1	42
Slovenia	25	61	7	29
Slovakia	10	56	6	50

Source: own elaboration based on Eurostat database.

4. Discussion and Implications

A socio-demographic situation in Poland, presented in the second part of the work, can be described as serious or worrying. It is characterized by a constantly growing group of older people with a relatively high share of the elderly in poor health, a very small number of doctors, and a poorly developed system of institutional support for older people (low expenditure on health

and social assistance). These conditions affect the ways how the care for the people who need assistance is performed. The Polish system of care for older people is described by the researchers describe as a transition model or Eastern European model. In this model, relatives as family or neighbors and friends bear the responsibility for their care. Such a system of support is also present in the Czech Republic, Hungary, Slovakia, Slovenia, Lithuania and Latvia (Krzyżowski, 2013, p. 61; Rosochacka-Gmitrzak & Racław, 2015).

In the context of an extended pressure on economic activity, increased migration of adult children, when there is a limited institutional support for carers, informal assistance is a difficult challenge. Rosochacka-Gmitrzak and Racław indicate that contemporary informal care for the elderly is a dynamic process (Rosochacka-Gmitrzak & Racław, 2015). This process is instrumental (invoving different activities, places, and interpersonal links) and emotional. Those involved in this process (both caregivers and dependent persons) experienced ambivalent emotions since there are various tensions, contradictions and anxieties occurring in the process of supporting older people in need of help.

It should be epmhasized that in Poland the largest group of the elderly live in households comprising their spouses and other people, but the share of the smallest households (elderly people living alone) is relatively too high (Kurkiewicz & Soja, 2015). The important issue is therefore not only institutional, but also psychological support for dependent persons and their caregivers. This applies to persons living together with older people and outside their households.

To respond to the challenges of population ageing, many stakeholders, such as institutions, practitioners, and researches are involved in healthy and active ageing strategies. The challenge for these strategies is to provide an environment that is rich in opportunities to bring more participation in employment and society and a greater capacity to live independently in old age (e.g. Soja & Soja, 2015a; Olsson, 2014; Tesch-Roemer, 2012).

The authors of the report "Responsible-Industry. A Framework for implementing Responsible Research and Innovation in ICT for an ageing society" emphasize the fact that in the field of ICT for an ageing society research and development there are several activities that bring to the development many systems and technological devices. However, only a few of them are on the market, purchased and used by elderly, their caregivers or medical practitioners (Porcari et al., 2015). They point to the "classic" barriers to market deployment of these products such as costs, relative complexity for implementation and also identify other important barriers, such as:

- lack of fit – many solutions are not properly designed to take into consideration the true requirements, characteristics and contexts of use,
- limited awareness (and skepticism) about the potential benefits of these products,
- resistance to accept changes in caring for the elderly (e.g. the use of human-machine interaction as robotics),
- ethical concerns (e.g. real time monitoring of the user lifestyle through "sensing systems" – e.g. environmental sensors for surveillance applications at home; "reasoning systems" for medical data analysis – e.g. detection of trend anomalies in vital signs to alert caregivers or family members).

Taking into account the socio-demographic conditions and the lower level of digital inclusion in Poland, we conclude that the indicated barriers may be important obstacles to practical use of ICT for social and health care in Poland.

It should be stressed that there is a particular need for public awareness about the possibilities of ICT for supporting social and health care. In Poland, lack of motivation to use ICT is still

the main reason for not having Internet access at home. Also, an important issue is the provision of relatively low-cost ICT products, due to low spending on care for the elderly and the relatively low incomes of Poles. In addition, a small number of doctors and widespread care for the elderly by their families is a challenge for researchers to thoroughly identify the needs and requirements for ICT products. More research is needed among the various stakeholders involved in social and health care:

- caregivers (living together with older or non-resident, frequently visiting) – research in the field of emotional support and practical help (e.g. social networks, ethical issues, e-government, e-services such as banking, shopping, entertainment, use of the advice of doctors online),
- older people with health problems – research in the field of practical and emotional support; ethical issues and alignment between ICT tools and the elderly skills due to their reduced physical and cognitive abilities (eg. Renaud & Ramsay, 2007; Soja & Soja, 2015a),
- older people in good health – research into problems in using ICT in health promotion and in everyday life, ethical issues,
- doctors, nurses and medical caregivers (e.g. recognizing the applicability of ICT, online support health care, ethical problems).

5. Conclusion

Currently, Poland is a country with a relatively low level of ageing population. Nevertheless, demographic forecasts show that in future ageing process will proceed with a faster pace in Poland and other CEE countries compared to developed countries from Southern, Northern and Western Europe. In Poland there is a constantly growing group of older people of relatively weak health status, which results in an increasing number of the elderly who need social and health care. Since institutional support for older people is poorly developed in Poland, care of the elderly is usually carried out by their relatives, who also need emotional and practical support. Information and communication technology (ICT) is a critical component of the contemporary world, offering a wide range of potential benefits in the field of healthcare. However, one of the main barriers to its widespread use is poorly developed digital inclusion in Poland. In this respect we can learn from the countries from the Northern Europe and also from Estonia, which despite being a post-transitional country seems to catch up with the leaders. Another group of impediments is related to the ICT products for health and social care available on the market. The actual barriers include lack of fit with the user needs, limited awareness about the potential benefits of these products, and ethical concerns related to their use. These barriers should be addressed by all countries, however, Poland has also take into consideration socio-demographic considerations associated with a family-based model of elderly care, lower level of social benefits, and relatively low incomes of Poles.

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Chapter 27

Public-private Partnership. Cases of Managing Digitisation in Museums with the Help of IT Sector

Jagoda Komusińska

1. Introduction

Non-profit cultural institutions are a unique kind of economic actor. They might be publicly-owned or they can be managed by non-governmental organisations, but their main economic characteristic is that they are not profitable. They are set up to provide high-quality cultural goods (the so-called "high culture"), which is usually considered a public good (Mankiw & Taylor, 2009). However, high culture is considered a public good mostly in the sense of a good that has to be sustained for the future generations, it is not as often-used or desired as other public goods like clean drinking water or roads. The offer of cultural institutions is not met with much demand (Strinati, 1998, p. 54). It is in contrast to the so-called "popular culture" or "entertainment", which – as the name suggests – is commonly purchased by large groups of consumers and is offered with a profit to its private producers. One of the reasons why "high culture" remains in the public sphere of protection is that there is too little private demand for it and no private enterpreneur would succeed in marketing its artifacts and services on commercial basis. Therefore the managers of cultural institutions are in an economically very specific and double-hard situation: (1) they have to fulfil their social mission "selling" their products to public, as if they were commercial products and in the same time (2) they have to compete with private vendors of commercial cultural products, although their products do not have the market appeal and are not as desirable by the consumers. High culture itself not being a commercial product is an alternative to popular culture (commercial products) in the eyes of the consumer. The role of the managers of cultural institutions goes beyond the framework of the "new public management" approach to public administration. They have to adapt to this tension and introduce innovative ways of management that can be inspirational also for managers in other sectors and can be interesting for researchers in the field of management studies. The following paper will present how contact with new information and communication technology (ICT) and technological progress changes the market presence of public cultural institutions – museums. The cases of public-private cooperation are described based upon interviews

conducted with and lectures given by managers of some of world's leading cultural institutions in June 2015.

2. Public-private partnership – definition and application to cultural institutions

Public-private partnership (PPP) refers to endeavours undertaken by public organisations which are bound to satisfy a public (non-commercial) purpose, but with the participation of a private, commercial entity which substitutes the public organisation in the execution of the task and may derive some private gains from it. Most commonly public – private partnerships are organised for infrastructural endeavours (private companies building social – housing estates, as ordered by the local government and so on). PPP is a means of avoiding privatisation of public services in the same time opening possibilities for private sector to grow. The equilibrium between the two sides of the contract is met, because the public party controls the quality and public availability of the investment (Hausner et al., 2013). In the case of public – private partnership in digitised culture content, it should introduce a new functionality of the content provider (like a museum), but also strengthen the creative sector – the private partner of the project.

According to a report by Ernst and Young (2014) in 2015 creative industries (including museums and digital marketing companies) made up for 4.2% of European GDP providing work for altogether 7 mln Europeans and the market is growing. The cooperation between public and private parties should be crucial in the following years to enable it to flourish. In another study, by Boston Consulting Group (2012), digital economy constituted about 4.8% of European GDP already by 2010 and it was dynamically growing (10% a year). BCG saw digital sphere of the economy as a hope for overall growth and source of welfare for developed countries. Also in the digital economy, creative industries constituted no less than 10% of it.

3. Digitisation – history and impact on cultural institutions (especially museums)

Digitisation is the process of transforming analogue resources in the possession of cultural institutions and archives into a digital form by scanning, uploading and publishing them online. Digitisation also includes providing specific software for managing the digital resources and displaying them. The software can be integrated with organisation's management IT systems. Digitisation of resources appeared in cultural institutions firstly in 1990's. For the first years it was done occasionally and upon order by researchers/art dealers/courts. With time, the marginal cost of producing a copy dropped significantly and mass digitisation of practically all owner physical objects started. Mass digitisation leads to unlocking the potential of the resources, of which usually 60-90% is hidden in the museums' warehouses (because of too little space in exhibition areas) (Stallabrass, 2006, p. 28). The potential mass availability of the resources was firstly met with fear and opposition by the museums managers due to the fact that "uniqueness" and "originality" had always been main competitive advantages of museums. Only 10 years ago the basic activity of the museums was attracting people to real-life visits, although they were not profitable. In the last 20 years the tickets would secure only 20% of the budgets of the museums (Instytut

Badań Strukturalnych, 2006, p. 78). The objects in the collection were only available on the spot. The museums had monopoly in this respect. The innovation that digitisation brought was seen as a threat. Internet was thought to draw people away from real-life visits to the locations. (However, to see the actual proportion of popularity of museums on the web and in reality it is good to quote that for example British Museum is visited by 25 million individuals online and by 6.7 million individuals on-site. Digitisation was smuggled into the institutions for good because the digitisation of the administrative processes (cataloguing, managing on-going activity, tagging) was welcome. In the most basic form, the digitised resources would be published on the existing websites and named/tagged. Only in the recent years the appearance of the resources is starting to change the virtual activity of the museums. The above-mentioned profound change in the marketing and branding of the social role of museum is only made possible thanks to very high human capital in those organisations. Employees are highly motivated (they receive low earnings, but the supply of workforce is very high and competitive as potential workers and driven by non-financial motivation). What is important to underline in the case of this type of public institutions, the employees are also creative (they are usually graduates in art-related disciplines) and open-minded/flexible.

Another factor that added altogether to the relatively fast adaptation of museums to new technology, was its organisational financial despair. For years the museums have been under-funded which drives them to look desperately for innovative forms of using its resources. In the same time they had to face a seriously changing social role. Because of changing patterns of consuming culture by potential clients, museums needed to re-define their role in 1990s becoming a platform for social meetings instead of serving as a repository (Fatyga, 2009, pp. 11-14).

There can be two innovative directions in which the simple process of digitisation changes the organisation of cultural institutions with the help of IT counterparts:

- Maintaining strategic partnerships with IT which provide personalised resource-management systems and websites which also allows the start-up IT companies to develop innovative solutions, later sold to business. Opening APIs of the websites enables the content to circulate and be present online, being used as raw material by programmers.
- Re-defining the role of marketing and archiving departments.

The examples of those two kinds of innovations will be described below. However by 2016 still the most common and widely spread form of cooperation between cultural institutions and private companies in the sphere of new technology is producing franchised products using digitised resources. It provides the museums additional sources of revenues. Digitisation gave a push to producing a wide array of products to be sold in the museum gift-shops (also on-line), amounting to 15-40% of museums' revenues. The other non-innovative, simple way of cooperation is outsourcing of digitisation services and website production. Thanks to outsourcing digitisation of resources their images are provided in a good quality and large quantity. It is usually the private counterpart who pays for the digitisation and also it is usually the one to publish it. This practice has some obvious advantages, however it is coupled by some serious threats. Digital heritage, owned publicly, can be privatised, and its distributional practices can endanger the privacy of users. One of more controversial aspects of outsourcing digitisation is the question, who becomes the owner of the digital images created and who gets the legal right to disposition the images. One of the major private players in the sphere of digitisation offering its services is Google, but there already appeared some start-ups which make digitisation its core business activity. The expert in copyright law Cory Doctorov (Tagholm, 2014) has already identified and described the legal caveats of a situation in which British libraries offering their books from public domain in the .pdf

format are obliged by the digitising company to "sell" them together with an embedded software – the so-callled Digital Rights Management Software, that gathers information about the readers. The digitisation company can later sell this data to marketing houses.

4. Examples of ground-breaking cultural institutions changing their audience-development policy

Metropolitan Museum of Art in New York is the leader in the sphere of using digitised resources to market the organisation making it competitive with private entertainment companies. It was the first one to appoint a position called "Chief Digital Officer". This executive post was created for Sree Srenivasan in 2013. His department is responsible for (1) digital communication of the organisation (2) experimenting with new modes of using digitised resources. His online activity philosophy is: "Even the oldest and largest organisations can be managed like a start-up. It is only a question of the approach of the employees and managers. MET is a leader, because we realised that we have four locations: the main building, the Cloisters buildings, the Breuer Building – all physical locations in New York – and our website. Any persons visiting any of our locations is just as precious to us and she is welcome to visit the remaining ones". In practice this philosophy is mainly incorporated into the online communication of social media marketing. According to Srenivasan the online mission of a cultural institution is to acquire new followers of the institution's profile by actively starting interactions with other users (the Museum profile would "like" the posts of people and institutions on Facebook and Twitter).

Another path of introducing innovation to the cultural organisation in managing their online audiences was the path taken by the Berlin Museum of German Jews. By 2014 the amount of digitised material called for creating a new website that would be clear to navigate to retrieve all digitised data. This instead served as an occasion to re-structure the communication of the organisation. The Museum managers used guidelines from the New Media Horizon Report: Museum Edition (2013): "Creating a website is an occasion to know the organisation better and to re-define its mission". In the case of the Museum of German Jews it turned out that it would be to create a community around the resources). The new version of website should simultaneously attract new visitors and encourage deeper interactions among those already active fans. According to the CEO of the Museum Miriam Wenzel: "Introducing a digital strategy is a process which requires setting-up organisational strategy. It is impossible to achieve without a culture of cooperation between employees and it must be fully inclusive, but the driving force behind creating such a strategy is always a customer-centred approach". This is why the website was being planned after conducting a survey on the old website visitors. On the basis of survey 18 "personas" (profiles of typical visitors) were created and all the designing decisions were made considering what would please those "personas" most. The "personas" procedure in website designing is one of the most challenging way of designing a website used to obtain the best user-experience.

Both the Museum of German Jews as well as Metropolitan Museum of Art are also followed by other institutions in how they decided to use their human resources and digitised resources in communication with the public opinion. To understand their possibilities in the respect of innovative, effective and diverse communication it is once again important to remember about the specific character of public cultural institutions. Unlike commercial companies in their communication with the public, the museums use the social media platforms to present their openness and organisational

transparency to the users, whereas commercial companies filter the information that they utter very carefully and they run superficial communication, not disclosing anything about their internal affairs. A museum can inform about the "backstage" work and the public will be interested in that. It is impossible to think that a commercial company would allow its offices or production lines to be seen. It is all kept a strict "commercial" secret. In the same time, unlike other public organisations, cultural institutions use the social-media in a very intensive and media-savvy way, because the employees have higher-than-average communicative skills. This mixture of organisational transparency and an outgoing attitude of employees results in dispersed, shared responsibility of various departments for communicating with the public. In the Berlin Museum of German Jews:

- press department would take on the role of running the Twitter account (because it has the most up-to-date information on the upcoming events. It produces 3-7 posts/day),
- marketing department covers the Facebook, Instagram and Google+ profiles (1-3 posts/day),
- media department runs production of clips for Youtube,
- museum blog is authored by 55 employees of the Museums securing a broad array of topics and approaches covered.

The division of responsibilities was prepared according to a different key in Metropolitan Museum of Art in New York. Over there the medium used to communicate to public is matched with the personality traits of certain officers responsible for it:

- Sree Srenivasan uses Twitter ("Twitter is emotional like me"),
- Thomas Campbell (Chief Executive Officer) uses Instagram, because he produces more contemplative, reflexive and aesthetic content,
- Marketing department runs the Facebook account – it employs editors trained in efficient communicating and art-history specialists for providing relevant, descriptive content.

In Polish public cultural institutions, cooperation with commercial companies usually takes the form of outsourcing generic marketing services. The other form of cooperation is renting museums spaces for company events (Instytut Badań Strukturalnych, 2010, p. 101). There are very few non-digitisation cases of cooperation. "Cultural sponsorship" is a rare form of promotion (Agrotec, 2015, pp. 96-100, 135). However there are also many cases of cooperation that other institutions look up to. The first such case is the impressive online platform created for Polona Natinal Library by Huncwot digital studio and EE Laboratory. It was a prestigious and challenging project of a tailor-made website with a multitasking search engine. A similar case of cooperation between cultural institution and creative design agency was that between Warsaw Uprising Museum and BrightMedia digital marketing studio. It prepared an innovative movie-like website that corresponds to the nature of the museum that was honoured with most important web-designing awards in the world and attracted international clients to the studio. Another form of promoting a local start-up was the case when Museum of Contemporary Art in Krakow ordered the beacon technology to be implemented by HG Intelligence and Contact IO companies from Krakow. Finally, also thanks to orders from public institutions the digital creations company New Amsterdam could start producing mobile applications and content-management solutions (Ekultura).

5. Conclusion

The museum is an entity that unites a publicly-funded organisation financing model with a market-approach of a commercial enterprise. They even have some advantages when it comes

to assessing the space for introducing innovation in an organisation. The managers of the modern-day museums use teams of highly-motivated employees with distinguished communication skills, thanks to whom their marketing strategy is competitive with the marketing methods of private investors active in the field of popular culture production. This trend is new and most probably only in the first stages of development. It can be expanded in the next years thanks to the new possibilities of distributing knowledge and information thanks to creation of ICT. The introduction of new technology spurred cultural managerial experts to involve into cooperation with private IT companies which results in blending the differences between publicly- and privately-produced cultural goods, which in turn can upgrade the quality of the cultural offer and its communication overall.

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