INFORMATION MANAGEMENT

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Preface

In this edition of conference book, authors and editors have taken challenge to address the most important aspects of modern Information Technologies. Those are the innovation, quality management of project, performance measures and widely perceived security.

The authors have been reflecting scientific and practical aspects of effectiveness, profitability, financial results of investing in new cyber economy. Moreover, those were presented in the face of increasing development of IT solutions we are faced those days in every industry. Even so the importance of delivering the final results is always valid but also the process of managing the quality and security of those solutions.

This book is addressed to community of science and corporation – it contains theoretical and practical information about application of various aspects connected to IT investments.

Firstly presented in the book is Earned Value as project management method based on regular comparison of the project's actual cost to the cost of work planned and performed. Authors presented this methods based on the IT projects there were involved in.

Quality in a project as stated in following papers is a matter of identifying and assuring those elements that will make parts of the projects and the final result correspond to their purpose. The area of quality management in IT project includes a set of actions that aim at delivering project products that comply with predefined quality criteria. Quality in delivering the final scope of IT projects is extremely important since small part of the projects is delivering on time and budget.

Next topic refers to the dynamic growth of corporate IT architectures and integration layers. Developed over the last years have to comply with knowledge about such systems in terms of quality and functional security. Looks like, we are lacking generic methods for identifying and solving issues related to control IT systems, in order to maintain the required level of functional security.

Presented Systems Dynamics is the method founded on an assumption that in the context of its dynamics, any system should be analyzed as a consistent entirety. This approach is entirely different from dissecting complex problems into subsets of less complicated components and analyzing them separately, as practiced traditionally procedure in science. Most important this model can be used for training project managers in forecasting the course of events in a project and predicting the impact of these events on successful implementation.

Next paper describes "elements of the good practice". To ensure adequate quality of the created IT system, it is necessary to have a high quality of project management in all activities, from the stage of formulating the work concept to the moment of delivery of the ready solution. In the sense of this, quality assurance is understood as a process in which the general results of the project will be evaluated to verify whether the project meets relevant quality standards.

The following work is related to the most critical aspect of modern IT systems – integration layer. The authors used following definition. "An integration platform is a set of interrelated elements, the purpose of which is to create an environment for IT systems co-operation in order to perform the functions and/or services requested by these systems users." Such definition assure the proper organization of information processing within the integrated platform, maintaining the required on-going functional reliability and assuring the on-going functional security hold equal interest of users, designers and security personnel as well.

Functional security of an integration platform is another element of an organization overall security and depends on the correct operation of the integrated IT systems in response to inputs. The integration platform functional security is achieved through building in specialized security configurations into the integration platform. Conclusion of the paper is that overall risk can be reduced down to an acceptable level through relevant technical and organizational measures.

Next paper refers to the subject of implementation of the integrated information system allowing elimination redundancy of data and significantly reduces the number of errors, being a result of multiple inputs of the same data by different employees. Moreover, it allows implementing a separate configuration for processes, based on complete system evaluation.

Assuming that software is a compound product is agreeable with most of us. Nevertheless a user or a potential customer is often not aware about consequences of certain solutions used in the software. Therefore, the models of software quality are of great importance. They allow identifying real company needs. The software implementation is a strategic decision influencing company development.

Finally two articles which focuses on the key area decisive to the success of IT projects and simultaneously with a degree of alignment IT – business and IT culture. This area is about defining of needs. Study on success factors of IT projects presented by the author were described the context of forecasted trends.

The book is also containing discussion about efficiency of IT spending is long lasting discussion. One of the possible models of assessing IT efficiency has been presented and practically used for Polish universal banks.

This book can also act as a guidebook for IT Management and decision makers, could provide also concepts and ideas for assuring maximized value of IT not only as a cost generator, but benefit provider. Some of the successful cases presented in this book, as well as academic approach of quantifying and underlying basics of IT.

The editors and authors of this book point their discussion to the top level enterprise management, leading scientists, bankers, officials and investors. Presented work is the summary of conducted researches and donates innovative solutions which concern variety of industry, banking, and public sector.

It is a privilege of Editors to thank all Authors involved in creating book for their valuable contributions and insights. We would like to thank in particular our Publisher Gdansk University Press. Special thanks and our appreciation go to reviewer Prof. dr Janusz Wielki (Technical University of Opole), who read the manuscript and helped to improve the material presented, to Vice Dean of Management Faculty at the University of Gdansk Prof. dr Wiesław Golnau, for the continuing support and valuable suggestions, and to dr Jacek Maślankowski (Department of Economic Informatics, Faculty of Management, University of Gdansk) who gave valuable contributions, encouragement and close support during the writing and printing of the book.

Bernard F. Kubiak
Andrzej Sieradz

Chapter 1
Adequacy evaluation of the simulation models of system dynamics on the example of the Earned Value model

Maciej Kiedrowicz, Jerzy Stanik

Introduction

The System Dynamics framework used in the present study is a method for constructing continuous simulation models, where the structure and the dynamics of complex systems and their processes can be modelled. The method has been designed for modelling complex systems with feedbacks, allowing for description of cause and effect dependencies between system elements. In the 60's, when working at Sloan School of Management Jay W. Forrester developed the basic principles of the method and presented them in many various publications. The method is founded on an assumption that in the context of its dynamics, any system should be analysed as a consistent entirety. This approach is entirely different from dissecting complex problems into subsets of less complicated components and analysing them separately, as practiced traditionally procedure in science. In System Dynamics, the process of modelling complex systems is based on two main structures:

- casual loops capturing the feedbacks in the system,
- stock and flows – variables reflecting the system's status at a selected point of time.

With these structures even very complex, non-linear relations can be visualized in models in a clear and comprehensible manner. What is also important about this method, any model can be easily adapted for current needs, e.g. in order to verify various hypotheses or new activity scenarios by adding new casual loops or state variables to the structure. All these features of the system dynamics methodology make it perfectly applicable to analysis of various classes of complex problems in nearly every discipline. Considering the facility of system dynamics models adaptation and modification, it is necessary to adopt suitable methods and tools when validating the adequacy of both the models and the outcomes generated by simulations performed by means of these models.

Evaluating the adequacy of any system dynamics model involves a systematized process which consists of a number of tests enabling one to find out, whether the model is valid, i.e. whether it describes real processes at a pre-set accuracy level. In order to test the model, a set of criteria for distinguishing between an adequate model and an inadequate one needs to be pre-defined. In the following chapters of this publication, an adequacy testing method is proposed for validation of an Earned Value based simulation model, which visualizes – among other aspects – the continuous nature of an IT project implementation monitoring and control.

1. The essence of evaluating the adequacy of a system dynamics simulation model

Any simulation model reflects a certain knowledge of real-life phenomena and processes. In order to validate the model and its ability to simulate the analysed reality, a formalised validation of the model's adequacy is required. The methods used to validate the adequacy of system dynamics models have been debated over for nearly as long as the method proper exists. When analysing the issue of system dynamics simulation model adequacy validation, one finds out that – in most general terms – it consists in developing tests for checking the model's structural and behavioural correctness, as well as its response to changes in decision-making rules.

Many authors are addressing the importance of building confidence in simulation models by performing a wide variety of tests covering such aspects as:

- model structure – tests designed to verify: model structure, model parameters, extreme conditions, model boundaries, dimensional consistency;
- model behaviour – tests designed to verify: correctness of the real system's behaviour reproduction (including anomalies), sensitivity to changes of parameters, statistical comparison of the model outputs to the values observed in the real system (object);
- stability of response to the decision-making policy changes – tests designed to verify sensitivity of the decision-making policy to changes in parameters.

At the same time, these authors understate the problem of statistical fitting the model outputs to the historical data recorded as a result of the real system (object) observation. They are stressing that any set of outputs can always be fitted to the required accuracy level, therefore models should be adequacy-validated mainly against criteria other than statistical fitting. The authors of the present chapter are of the opinion that an approach like this cannot be accepted altogether, for the following reasons:

- most users expect a formal method for validating the correctness of simulation models provided to them;

- although statistical diagnosing of the system dynamics model goodness-of-fit to data observed in real systems (objects) is not a sufficient criterion for finding the model to be correct, its role in the process of building confidence in the model is invaluable, as it allows for the partial formalization of the model adequacy validation;
- a well-constructed system dynamics model has to reflect historical (past) behaviour of the system (object) correctly based on historical data and to allow for a similarly correct prediction of its future behaviour based on the pre-set parameters.

2. The problem of statistical evaluation of the system dynamics model adequacy

The present work is an attempt to analyse the adequacy of a system dynamics model by means of statistical methods used for evaluation of model's behavioural validity. The authors have reduced the problem to development of decision-making rules which – based on the results of experiments performed with the use of a certain model – will provide a basis for identifying the degree of its "correctness" through fitting the model-generated values to the historical data from the system.

To identify the model fit error in system dynamics simulation, Theil's inequality statistics are often used. This approach deserves special attention among the entire collection of tests designed for this purpose, since it enables identification not only of the total magnitude of error, but also of its cause. The construction of these statistics is based on the causes of simulation models lack-of-fit to the real objects characteristics, observed in the practice of these models construction, where one of these causes is weakness of the model (systematic error), the other one being the randomness of historical data (random error).

The base subject to decomposition is the value of mean squared error (MSE) given by the following equation:

$$\sigma^2 = \frac{1}{n}\sum_{t=1}^{n}(S_t - A_t)^2, \tag{1}$$

where: n – the number of observations, S_t – value generated in simulation at moment t, A_t – value from the real object observation at moment t. The value given by formula (1) can be decomposed into three components:

$$\sigma^2 = (\overline{S} - \overline{A})^2 + (S_S - A_A)^2 + 2(1 - r)S_S A_A, \tag{2}$$

where: $\overline{S}$, $\overline{A}$ – mean (arithmetic) values; S_S, A_A – standard deviations, r – coefficient of correlation between values from simulation and real values. The element defined as $(\overline{S}-\overline{A})^2$ represents deviation between the simulated and real series of data. The divergence between the variance of these series is measured by $(S_S - A_A)^2$. The degree of value divergence point by point (covariance) is represented by component. Having divided both sides of dependence (2) by (1) the following is obtained:

$$1 = U^M + U^S + U^C, \tag{3}$$

where: U^M – measures the share of systematic error in the value of mean squared error, U^S – measures the share of error caused by variance inequality in the value of mean squared error, U^C – measures the share of error caused by covariance inequality in the value of mean squared error. These statistics are given as follows:

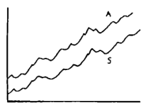
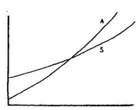
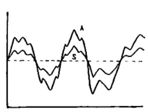
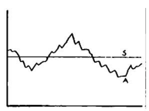
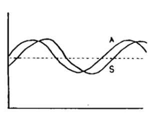
$$U^M = \frac{(\overline{S}-\overline{A})^2}{\sigma^2}, \tag{4}$$

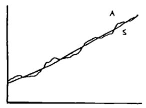
$$U^S = \frac{(S_S - A_A)^2}{\sigma^2}, \tag{5}$$

$$U^C = \frac{2(1-r)S_S A_A}{\sigma^2}, \tag{6}$$

and their interpretations are presented in table 1.

Table 1. Interpretation of Theil's statistics

It.	Sequence	U^M	U^S	U^C	Description	Interpretation
1.		1	0	0	$S_t = A_t + k$ (S equals A following shift by constant k)	Systematic error
2.		0	1	0	$S_t - \overline{S} = k(A_t - \overline{A})$	Systematic error (S and A are showing different trends)
3.		0	1	0	$S_t - \overline{S} = k(A_t - \overline{A})$	Systematic error (S and A have the same phase, but differ in amplitude)
4.		0	1	0	$S_t - \overline{S} = k(A_t - \overline{A})$	Non-systematic error (unless the model has been designed to analyses A cycles)
5.		0	0	1	$S_t - \overline{S} = k(A_t - \overline{A})$	Probably non-systematic error (S and A have the same means and variances, but different phases)

It.	Sequence	U^M	U^S	U^C	Description	Interpretation
6.		0	a	a -1	$A_t = f(t) + e(t)$, where $e(t) = 0$, (S equals A, except differences resulting from various error values)	Non-systematic error, unless the model has been designed to analyse periodicity of A (S and A have the same means and trends, but differ "point by point")

Source: [Sterman, 1984].

The simulation model will be validated based on quantities (4), (5) and (6) by means of a decision-making function defined as follows:

$$d(U^M, U^S, U^C) = \begin{cases} h^0, \text{if } U^M \in \langle 0, 0.1 \rangle \wedge U^S \in \langle 0, 0.2 \rangle \wedge U^C \in \langle 0.8, 1 \rangle \\ h^1, \text{if } U^M \notin \langle 0, 0.1 \rangle \vee U^S \notin \langle 0, 0.2 \rangle \vee U^C \notin \langle 0.8, 1 \rangle \end{cases} \quad (7)$$

where:
h^0 – there is no ground for rejecting a hypothesis of the simulation model adequacy to real processes;
h^1 – the outcomes contradict the hypothesis of the simulation model adequacy to real processes.

3. Statistical evaluation of the simulation model adequacy on the Earned Value model example

The authors focussed on adequacy evaluation of a model constructed with the use of the System Dynamics method, based on the Earned Value concept. The model has been built based on the outcomes obtained by R.J. Madachy and presented in [Madachy, 2008]. The authors calibrated the model, using data collected in various IT projects they participated in. The model adequacy was tested in terms of how ACWP and BCWP variable values generated by the model fit data from a real-life IT project. With this end in view, the tools proposed in the present chapter – i.e. Theil's statistics (4), (5) and (6) – have been used, as well as the decision making function (7).

Earned Value is a project management method based on regular comparison of the project's actual cost to the cost of work planned and performed. The technique was termed "Earned Value" to reflect the idea that some planned cost, i.e. "value" is assigned to each and any project deliverable. When the project is complete, its "value" has been "earned" under the project. At he same time, an approach like this, based on continual monitoring of a project at every stage of its implementation, identifies any delays in schedule performance and cost overruns, thereby giving an opportunity to take adequate actions aimed at minimizing the risk of project failure. Moreover, the process of project tracking follows also the actual value of work, products and services accomplished as of the moment when the review is taking place. Thereby, three characteristics can be compared: the planned cost (BCWP – Budgeted Cost of Work Scheduled), the Actual Cost of Work Performed (ACWP), the earned value (BCWP – Budgeted Cost of Work Performed) and project performance variance, such as Schedule Performance Index (SPI) and Cost Performance Index (CPI).

Figure 1 presents the simulation model built according to the Earned Value rules with the use of Vensim® simulation environment. The model was used to perform a simulation experiment, the results of which provided inputs to the process of model adequacy evaluation.

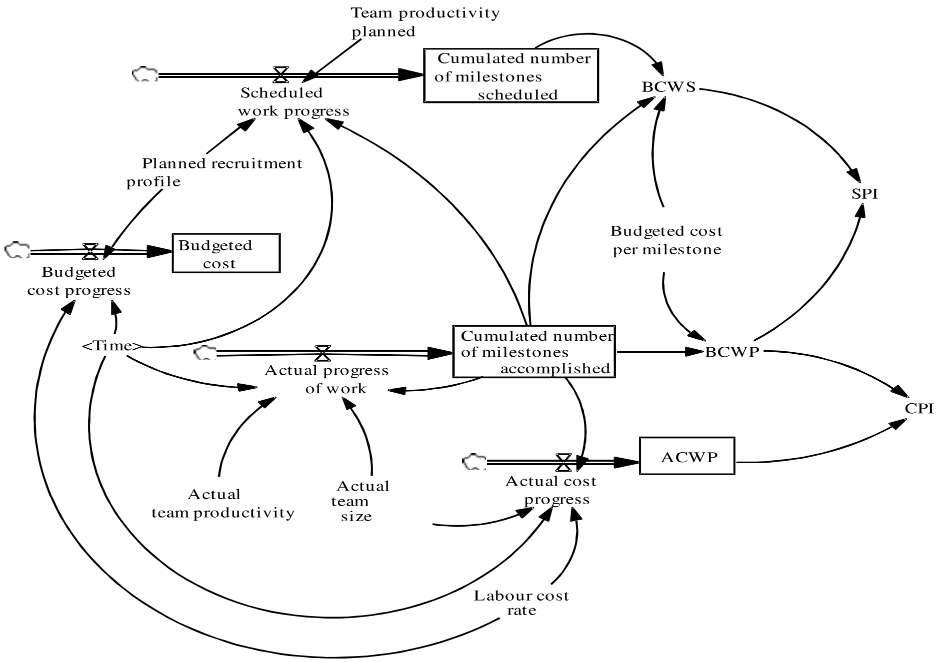


Figure 1. Earned Value simulation model

Source: Own elaboration.

The graph below (figure 2) compares the outcomes of simulation to data collected during implementation of the real-life IT. These were used as inputs to Theil's statistics, the values of which are presented in table 2.

Table 2. Calculated values of the Theil's statistics

Variable	U^M	U^S	U^C
ACWP	0.03	0.13	0.84
BCWP	0.00	0.10	0.90

Source: Own elaboration.

The high value of U^C and relatively low values of U^M and U^S give evidence to a non-systematic error, which might be caused by significant fluctuation of parameters determining the actual performance of the project team. Based on the above outcomes and the decision-making function (7), a conclusion can be drawn that there is no ground for rejecting the hypothesis of the simulation model adequacy to the real processes.

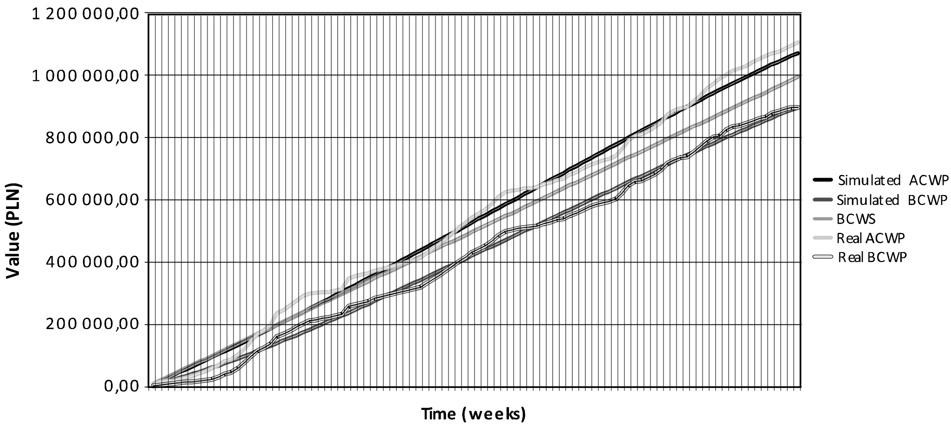


Figure 2. Comparison of the results generated by the simulation to the real project data
Source: Own elaboration.

Conclusion

The present chapter presents the Earned Value model constructed using the System Dynamics based simulation tools. The model has been calibrated and validated by a decision-making function proposed by the authors and based on Theil's inequality statistics. The outcomes show that the model and the resultant simulations can be an excellent tool for tracking implementation of IT projects. Moreover, the model can be used for training project managers in forecasting the course of events in a project and predicting the impact of these events on successful implementation of the project through what-if scenario analysis based on changes of such key characteristics as e.g. the project team size, the team performance profile, the recruitment profile, etc.

References

1. Barlas Y. (1996), *Formal aspects of model validity and validation in system dynamics*, "System Dynamics Review", Vol. 12, No. 3.
2. Forrester J.W., Senge P.M. (1980), *Tests for building confidence in system dynamics models*, TIMS studies in the management sciences 14, North-Holland.
3. Madachy R.J. (2008), *Software process dynamics*, Wiley, New Jersey.
4. Martis M.S. (2006), *Validation of simulation based models: a theoretical outlook*, "Electronic Journal of Business Research Methods", Vol. 4.
5. Qudrat-Ullah H. (2011), *On The Validation of System Dynamics Type Simulation Models*, Telecommunication Systems, Springer Netherlands.
6. *Practice Standard for Earned Value Management*, Project Management Institute, 2005, Pennsylvania.
7. Sterman J.D. (1984), *Appropriate summary statistics for evaluating the historical fit of system dynamics models*, "Dynamica", Vol. 10.
8. Sterman J.D. (2000), *Business Dynamics. System thinking and modelling for a complex world*, McGraw Hill.
9. Vargas R.V. (2004), *Earned value probabilistic forecasting using Monte Carlo simulation*, Transactions of the American Association of Cost Engineers.
10. Wakeland W., Hoarfrost M. (2005), *The Case for Thoroughly Testing Complex System Dynamics Models*, Papers for the 23rd International Conference of the System Dynamics Society, Boston.

Chapter 2

Quality management in information technology project "elements of good practice"

Jerzy Stanik, Robert Waszkowski

Introduction

Quality in a project is a matter of identifying and assuring those elements that will make the parts of the project and the final result correspond to their purpose i.e. the satisfaction of the specified needs of end users of a system and compliance with the customer's quality expectations.

To ensure adequate quality of the created IT system, it is necessary to have a high quality of project management in all activities (from the stage of formulating the work concept to the moment of delivery of the ready solution).

It is assumed that a process properly implemented by the Project Manager at the very beginning and which aims to assure quality, translates into all the later activities of the project team throughout the entire period of project work. Quality assurance is understood as a process in which the general results of the project will be evaluated to verify whether the project meets relevant quality standards.

1. Approach to project management

The area of quality management in an IT project includes a set of actions that aim at delivering project products that comply with predefined quality criteria. The results of the project must comply with the quality expectations of the client. The first goal of quality management in a project environment is to guarantee that the quality expected by the system's client (defined in the quality expectations of the client) will be delivered during project execution and will go beyond the delivery of the final result. Quality assurance is served by a comprehensive set of structures, procedures and processes that facilitate quality management. The purpose of activities related to quality control is to verify whether the delivered products meet the adopted quality criteria.

There are three areas of the quality management system that need to be taken into account in the adopted approach:

1) **project management**: quality assurance in the area of project management through the application of a standard (e.g. the PRINCE 2 methodology) of

project execution (from the beginning stage through the execution stage to the completion stage) as well as control tools for the individual areas of the project. Project management activities have been defined in the area of project management which are subject to standardization as well as standards, procedures, methods, tools and expected values;

2) **process management**: quality assurance of the production process related to the method of supplying specialized products through the application of a standard of production (e.g. RUP methodology) of software and control tools for individual program modules. This means the adoption of a certain model of actions aiming to deliver the relevant user software – system application;
3) **project products**: conducting control activities to verify whether the produced products comply with the expectations. Verification activities apply to both final products as well as intermediate products (e.g. specification of requirements, system architecture, etc.).

It is not possible to handle these three areas separately by, for example, attempting to obtain a high quality of the product with negligent management. It is important not to confuse the concept of grade (product class) with quality which are often treated as equivalent. Low quality will always be an issue whereas grade does not have to be a problem. For example, software may have a high quality (no errors, good operation manual) and a low grade (limited number of options) or have a low quality (program errors, illegible manual, complicated operation) and a high grade (large number of various functions). Ensuring a differentiation between product class and quality is very important and is the duty of both the project manager and the team.

Despite some common traits of quality management and IT project quality management, there exists one basic difference: projects are temporary ventures and, for this reason, it is not always possible to ensure high quality in the execution of the project itself if high quality is not assured by the organization in each aspect of its activity. The first stage of performing a quality management strategy in an IT project consists of quality planning i.e. defining which quality standards are relevant to the project and how they can be achieved. Quality planning should take into account such factors as:

- company policy – if there is no general quality policy in the company, own rules should be created that can be used in the specific project;
- specification of project objectives – enables the precise definition of what needs to be achieved and, therefore, the definition of the type of requirements that the project's product needs to satisfy;
- standards and norms – their analysis will make it possible to establish to what degree they may affect the project;

– impact of other processes – the analysis of such an impact makes it possible to estimate the degree to which the project's quality may depend on the quality of other elements e.g. supplied resources, materials or team member competences.

The above factors should be combined when conducting different types of analyses. The following methods may be applied in this case:

1) profit and cost analysis – it is generally known that increasing the quality level entails higher costs. The purpose of such an analysis is to establish the ratio of costs incurred to the quality obtained that will be most satisfactory;
2) benchmarking – consists of a comparison of conducting the current project with other similar projects to illustrate the differences in achieved results and thereby prepare actions that will improve the project process;
3) flowcharting – an analysis consisting of the definition of the mutual impact of the individual elements of the project and the possible result of such impact. The methods used in this case are as follows:
   - traditional methods: checklists, point charts, time charts, control charts, cause and effect diagrams, block diagram, Ishikawa diagram, Pareto diagram, Pareto-Lorenzo diagram, histogram, control spreadsheets, correlation graphs, Shewhart control chart;
   - modern methods: relation diagram, affinity diagram, matrix diagram, matrix data analysis, decision process program graph, arrow diagram;
4) process flowcharts illustrating the dependencies between the individual system elements;
5) experimental analyses – most often used for technical projects; consist of an experimental verification of specific parameter combinations and enable the selection of the most optimal solution.

The performance of the above analyses enables the creation of a compre-hensive quality management plan that will describe the actions necessary to ensure adequate project quality as well as enable the control of such actions.

2. Selected elements of the quality assurance plan

2.1. Quality objectives

Quality is included in plans and not achieved as a result of later inspections. The purpose of quality planning consists of the following:

– definition of the quality required of project products,
– planning of the method of approaching quality – preparation of a Project Quality Plan.

The final products of the Project that need to be delivered to the customer must be characterized by high quality and must comply with the requirements, the project specification, the standards adopted in the project, and, furthermore, must be reliable, error free, safe, useful, intuitive in use, effective, etc.

The expected high quality of products is achieved following the satisfaction of the following conditions:

– definition of a quality policy for the project,
– implementation of a quality system in the project which encompasses the organizational structure, procedures and processes to implement quality management,
– implementation of quality supervision which creates and maintains the quality system and monitors its use for the purpose of ensuring that the adopted quality system functions and is effective in reaching a final result that meets the quality requirements of the client and other requirements contained in the specification of requirements,
– implementation of a quality planning process that defines the goals and requirements related to quality and recommends actions promoting the use of the quality system,
– implementation of a quality control process which is a method of ensuring that the project products meet their respective quality criteria,
– inclusion of the project management methodology and the methodology of project product generation,
– deliberate management and updating of the client's requirements so as to ensure that the client is satisfied and the project is performed according to schedule,
– performance of project reviews.

The preparation of a Project Quality Plan consists of the following, among others:

– identification of the quality system that is to be adopted by the project and the way that Project Supervision will be organized,
– agreement of the client's quality expectations,
– definition of the project acceptance criteria,
– agreement of the approach to be used in the project for:
  - change management,
  - configuration management,
  - risk management.

2.2. Quality metrics

At the management level, quality metrics serve the Project Manager to follow the work progress and, if any anomalies are identified, to effectively react with extraordinary actions.

The principal elements in this scope consist of:

- earned value management (EVM) – method of measuring project performance; compares the planned work outlay and the actually earned value and associated expenses thereby enabling the conclusion of whether the time efficiency and the cost efficiency comply with the plan,
- control of the performance of the adopted time schedule of work,
- project cost management,
- project resources management,
- project scope management.

The basic quality criteria of documentation products consist of the following:

- structural correctness (division into sections, transparency),
- compliance with standards (linguistic and formal correctness, semantic and topographic coherence),
- completeness (in the context of the agreed subject matter scope to be substantially prepared),
- cohesion and incontestability (maintenance of a logical continuation of entries at the local level i.e. in one document as well as on the global level i.e. in different documents that take into account the same merits).

In the case of specialized products, it is worth considering the preparation of a Software Metrics Program (figure 1). Such a program would ensure a complete and credible control and quality improvement mechanism in all areas of the production process, including functionalities, uses, reliability, efficiency, availability and safety.

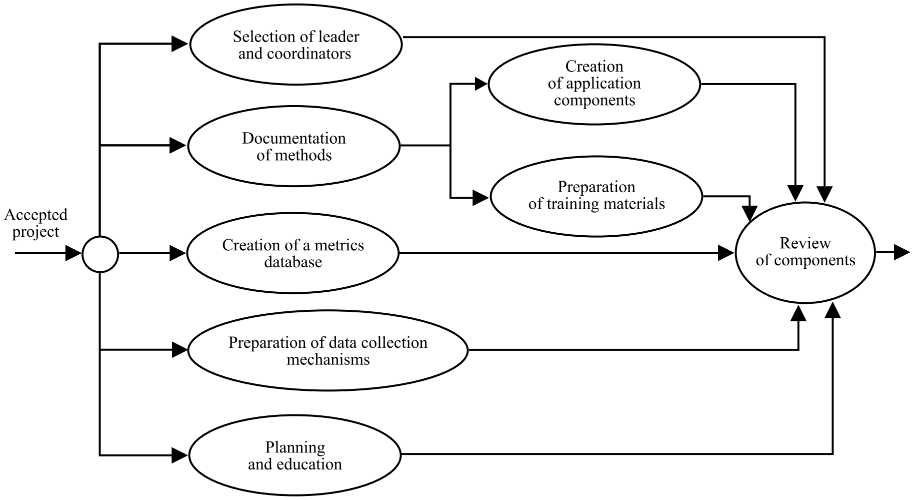


Figure 1. Preparation of a Software Metrics Program

Source: Own elaboration, based on Software Metrics Best Practices For Successful IT Management.

Within the scope of work on the produced software, it is necessary to select the metrics that are relevant to the individual specialized products.

2.3. Plan of reviews and quality audits

A quality review is a process the supports project managers in the identification of problems related to the project and enabling the preparation of recommendations related to the method of solving the problem. A quality review aims at:

- evaluating the compliance of the product with the agreed criteria,
- providing a basis for product improvement,
- introducing all parties interested in the product to the quality control,
- delivering a mechanism for monitoring and managerial control.

The following products will be subject to a quality review:

- Requirement Specification Document,
- System Architecture,
- System Project.

A quality audit is a process used to confirm whether the quality control procedures in the project are running correctly. A quality audit defines the methods of improving the procedures within a project; it also specifies the capacity to maintain the project at the assumed quality level. Each project should include the performance of the following quality audits:

- audit of functionalities,
- IT audit,
- telematics safety audit.

The verification of the system and its components is conducted as follows:

1) the verification of system requirements is performed at the requirements stage. Once the verification is complete, the Requirement Specification Document presenting the fixed part of system requirements is accepted;
2) the verification of the designed system is conducted at the end of the system design stage and after the approval of the system model;
3) the verification of system modules is conducted during the implementation and testing stages; each module is verified and tested separately by a programmer responsible for that module. Next, a verification of the cooperation correctness between individual modules is conducted and finally, the correctness of application operation is verified at the level of the entire system;
4) if any errors are identified at the respective project implementation stages, they should be corrected by relevant persons as soon as possible.

The application testing process (system software modules) describes all the actions and resources that participate in the testing. The testing process consists of:

- tasks (activities),
- products (task inputs and outputs),
- roles of persons,
- metrics related to testing and their interrelations.

The following need to be prepared when beginning the testing process:

- test project,
- test plan,
- test procedures,
- list of tested products,
- scenarios of integration tests,
- test cases,
- list of test agents,
- test types,
- testing methods,
- testing repository.

2.4. Tools, techniques and methodologies

To perform the tasks and to achieve the goals of project quality and the goals stemming from the performance of the project quality policy, it is necessary to have a set of means that makes it possible to shape project product quality at all stages of its lifecycle. A specification of quality creation instruments (tools, techniques, methodologies and rules) that will be used during the performance of activities related to project quality assurance have been presented in table 1.

Table 1. List of tools, techniques and methodologies that will be used during the performance of quality assurance activities

Name of group	**Characteristics and method of influencing the quality of project products**	**Examples**
Quality management rules	Long-term impact, Define the relation of the Project and its employees to generally understood quality problems, Specify in a simple concise form the main goals and rules of Project Quality Policy conducted by the Project's Steering Committee, Support the implementation of the Project Quality Policy and the Project Quality Management System, Do not directly deliver tools and action methods, Define the development strategy and the maintenance of the IT system, Go beyond the framework of this project, Do not provide operational guidelines, Usage results are difficult to assess on a current basis.	• Deming principle, • Principle of "continuous improvement of processes" – Kazein, • "Zero defect" rule, • "Mistake proofing" rule – Poka-Yoke, • Teamwork principle
Quality management methodologies	Medium-term impact, Based mainly on generally accepted standards of IT project management, Based mainly on generally accepted standards of software production.	Management methodologies: • PRINCE 2, PMI Book, MSP • Production methodologies: RUP, CDM
Quality management methods	Medium-term impact, Characterized by a planned, repetitive and scientifically based method of conduct during tasks related to quality assurance, Facilitate the shaping of project quality and IT system preparation quality, Based mainly on generally accepted proceeding algorithms.	• Quality function development method– QFD, • Failure mode and effects analysis – FMEA, • Experimental methods in design – Shainin's method, • Control methods, • Quality capacity analysis methods, • Comparative evaluation, • Quality cost, • Analysis of profits and costs, • Teamwork method.

Name of group	Characteristics and method of influencing the quality of project products	Examples
Tools and techniques of quality management	Short-term impact (operational), Results of use visible "almost" immediately but effective use requires combination with methods and/or methodologies, Serve the collection and processing of data related to quality assurance, Are supervision (monitoring) instruments and tools for diagnosing design processes, implementation, testing and control, as well as any other actions existing in the IT system use cycle, Their significance stems from the fact that without reliable and full information it would be difficult to take effective actions in the scope of a systematic improvement of quality	Traditional tools and techniques: • Inspections, • Quality audits, • Block diagram, • Ishikawa diagram, • Pareto diagram, • Pareto-Lorenzo diagram, • Histogram, • Control spreadsheets, • Correlation graphs, • Shewhart's control charts. • Modern tools and techniques: • Relation diagram, • Affinity diagram, • Matrix diagram, • Matrix data analysis, • Decision process program graph, • Arrow diagram.

Source: Own elaboration.

2.5. Configuration management

Configuration management plays a key role in the control of project quality. Configuration management contributes to the economic generation of products with the expected quality by:

- making change and product update management cheaper and less exposed to errors,
- helping identify the products that may be affected by the effects of problems related to other related products,
- checking which product versions the user is using or is related to; are the use products approved, have the products been influenced by changes and which other related products may be the cause of problems.

Configuration management in a project will include five basic functions:

- planning: deciding which configuration management level will be required in the project and planning the way by which that level will be achieved,

- identification: specification and identification of all the components of the final product,
- steering: ability to agree and set reference objects of products and then making changes solely upon the acceptance of relevant and formally defined organs,
- status definition: recording and reporting of all current and historical data related to each product,
- verification: series of reviews and configuration audits to ensure that the actual status of all products is created according to the approved product status registered in the configuration management entries.

To ensure high quality in the project environment a separate document entitled "Configuration Management Plan" should be prepared for the project. The document defines the following:

- how and where the products will be stored,
- what will be the security for their input and access to them,
- how will the products and their successive versions be identified,
- who is responsible for configuration management.

2.6. Supervision over suppliers and subcontractors

The list of duties related to supervision over suppliers and subcontractors in light of project quality assurance has been presented below:

- close communication between the supplier and the client or contracting entity is maintained throughout the entire lifecycle of the project,
- project risks are controlled,
- relevant persons participate in the creation of product descriptions in the scope of their quality criteria,
- involvement of relevant persons to control the quality at the right moments of project product production has been planned,
- the personnel is properly trained in the scope of quality control procedures,
- the relevant persons participate in quality control,
- review/quality control procedures are properly performed,
- follow-up activities resulting from quality control are correctly performed,
- the applied standards are relevant and possible to apply,
- quality assurance standards are complied with.

2.7. Quality register

In order to ensure a high quality of the project a quality register should be maintained for the project. The purpose of the register is to:

- assign a unique reference number to each quality control,

- serve as a cross-reference to quality control documentation for the product,
- serve as a specification of the quantity and type of conducted quality controls,
- the quality register lists all quality controls that are planned or that have been conducted and provides information to the final report of the project and to the report on experiments.

Each entry to the quality register should contain:

- a reference number,
- an identifier and product name,
- the method of quality control,
- the responsible personnel, roles, names,
- planned review date,
- actual review date,
- review result,
- quantity of actions,
- planned date of approval,
- actual date of approval.

The first entries to the register are made when the quality control or test is introduced to the Project Stage Plan. Other information is taken from the actual performance of a control. The date of approval means the day on which all remedy actions have been approved with a signature.

The initial clean quality register is created during the subprocess of quality planning. The role and responsibility needs to be defined to maintain the register. A procedure guaranteeing the entry of each quality control to the register is also necessary.

2.8. Risk management

The undertaking of risk for this project is inevitable. Risk management is meant to control the degree of project exposure by undertaking actions that maintain the risk at an acceptable level. Specific rules of treating risk should be defined as well as the levels of risk tolerance. The defined assumptions related to the risk level should be verified throughout the entire lifecycle of the project, at least during each final evaluation of a stage. Risk management requires the following:

- access to credible and current information on threats (risk register),
- decision-making processes supported by a risk analysis and assessment method included in the framework (risk management cycle),
- implemented threat monitoring procedures, proper balance of control elements used to manage risk.

Risk management is one of the most important parts of work performed by the Steering Committee and the Project Manager. The Project Manager is obliged to ensure that the threats are identified, registered and regularly reviewed. The Steering Committee has the following duties:

- notification of the Project Manager of each external threat to the project,
- adopting decisions related to reactions to threats recommended by the Project Manager,
- finding a balance between the risk level and the potential benefits that affect the ability of the project to perform the project objectives.

A risk register should be maintained for the project in order to ensure its high quality.

Conclusion

Quality issues of IT systems that have hitherto not been paid particular attention have become the object of large-scale studies. The quality of produced IT systems has depended on the experiences and skills of the production team. When the cost of computer hardware is decreasing and the costs of producing IT systems rise (system care costs are particularly high), the matter of quality has gained an adequate importance. New methods of producing IT systems emphasize the creation of high quality.

The creation of an IT system with attention to compliance with quality criteria is adopting a user-directed approach, contrary to the often found practice of designing oriented towards the use of the possibilities offered by tools (tool-driven design) or the cutting of production time by preparing generic tasks (task-driven design) and their further adaptation to specific requirements. The most important direction in software engineering development is the acceptance of the dominant role of the user. An IT system is a product that has to be useful i.e. improve and simplify the user's work while remaining convenient to use, easy and safe to operate. It is not enough for the system to be developed according to accepted rules and to be technically elegant. The most important criterion of product usefulness is the user's opinion.

Quality requirements are met by shifting focus from detail design and coding to the management level and the stages of planning, analysis and implementation. Quality assurance of the IT system is provided through recommended standards of project management and the preparation of requirement specifications, standards for modeling, design and through the preparation of a quality assurance plan for the IT system and a system testing plan.

References

1. *Effective project management PRINCE 2*, 2008 edition
2. Hamrol A., Mantura W. (2008), *Zarządzanie jakością. Teoria i praktyka*, Wydawnictwo Naukowe PWN, Warszawa.
3. Philips J. (2005), *Zarządzanie projektami IT*, Helion, Gliwice.
4. Stanik J. (2001), *Zapewnianie jakości systemów informatycznych*, PLOUG, Zakopane.

Chapter 3
The concept of maintaining functional security of an integration platform

Jerzy Stanik, Tomasz Protasowicki

Introduction

The rapid growth of corporate architectures and integration platforms (IP) observed over the last years keeps ahead of knowledge about such systems quality and functional security. Besides, we are lacking generic methods for identifying and solving tasks related to control of these systems current functional properties, in order to maintain the required level of functional security. Difficulties with offering a formula for functional security management and rules for the current security level management result mainly from the special features of integration platforms being corporations' basic fit-out today.

Out of many definitions encountered in the information platforms theory, the following one quoted after [Górski, 2012] meets the requirements of this chapter best: "An integration platform is a set of interrelated elements, the purpose of which is to create an environment for IT systems co-operation in order to perform the functions and/or services requested by these systems users."

Such aspects as proper organization of information processing within the IP, maintaining the required on-going functional reliability and assuring the on-going functional security hold equal interest of IP users, designers and security personnel as well.

1. Description of an integration platform for the purpose of properties and functional security management

Figure 1 presents a graphic illustration of an IP from the perspective of controlling its current functional properties and maintaining the on-going functional security.

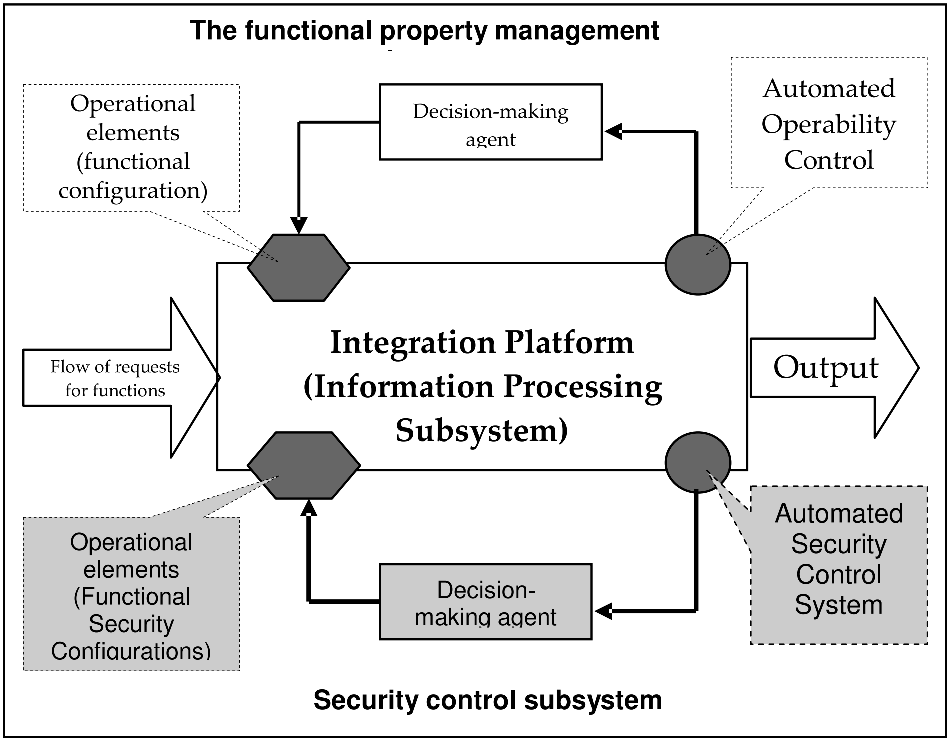


Figure 1. Illustration from the perspective of controlling its functional properties and functional security

Source: Own elaboration.

The illustration shows three important elements:

- an integration platform as a controllable object,
- a subsystem for controlling functional properties,
- a subsystem performing security functions.

To control functional properties, an appropriately prepared software application is required in the IP information processing subsystem, i.e. special procedures enabling generation of the right functional configurations. Moreover, to control IP's functional properties, relevant procedures for automated operability control are needed in the information subsystem.

To control functional security, an appropriately prepared software application is required in the IP, i.e. special procedures enabling generation of the right security configurations and relevant procedures for automated loss of functional security.

2. An integration platform as a controllable object

2.1. The integration platform model

A structured four has been assumed as an integration platform model for the purpose of functional properties management and functional security assurance:

$$\langle KF, KB, DS, FR \rangle \tag{1}$$

where:
KF – a family of acceptable functional configurations and

$$KF = \{KS^{v}, v = \overline{1, A}\}$$

where:
v represents the number of emergency situations identified,
KB – a family of acceptable security configurations, where

$$KB = \{KS^{u}, u = \overline{1, U}\}$$

where:
u represents the number of functional security losses identified,
DS – a set of permissible control decisions, hereinafter referred to as directives, which can be used by the corporation's functional security team members for determining the current properties of functional configurations and functional security,
FR – general reconfiguration function.

In order to be able to continue effectively the safe process of information assets processing, an optimal or suboptimal security configuration should be generated after any loss of security.

2.2. The information processing subsystem

It is a special feature of the information processing subsystem that all physical actions are related to operations on information sourced from the integrated IT systems of the integration platform.

It is assumed that set Z^{PI} of tasks performed by the platform comprises:

1) control of message flow routing between the integrated IT systems,
2) storing and queuing messages in case of temporary inaccessibility of the target IT system,

tasks of collecting, storing and providing access to information as needed by the user, in an automated manner, by means of IT equipment, information processing tasks, as per the IP logic and technological rules.

From the perspective of the IP information processing process, the agent is represented by workstations set *SP* – end user workstations, while the object is represented by a set of such elements $e_j \in E^{PI}$, on which the purpose of the information processing subsystem is determined. Elements of set E^{PI} are portions of information received by the information processing subsystem (figure 1). These portions characterize the demand for applications or services requested by the integration platform users. They are formed automatically, according to pre-defined standards, by the IT systems communication software and are subject to further processing. Each portion of information constituting an information asset is assigned number $p \in P^{PI}$ and described by set C_p^{PI} of features names.

3. The Functional properties management subsystem

3.1. The agent

From the perspective of information assets processing, the agent is represented by set of workstations *SP* – end user workstations, while the object is represented by set of such elements $e_j \in E^{PI}$, on which the purpose of the information processing subsystem is determined.

Elements of set E^{PI} are portions of information received by the information processing subsystem (figure 1). These portions characterize the demand for applications or services requested by the integration platform users. They are formed automatically, according to pre-defined standards, by the IT systems communication software and are subject to further processing. Each portion of information constituting an information asset is assigned number $p \in P^{PI}$ and described by set C_p^{PI} of features names.

If we number all differing sets of features describing individual information assets with variable $b = \overline{1, B}$ (which we shall name an information asset type), then two assets are of the same type (e.g. "b"), when described by identical sets of features. Sets Ω_p^{PI} of features numbers, describing the asset and corresponding sets of features C_p^{PI}, cannot be empty for each $p \in P^{PI}$, where P^{PI} is a set of numbers of distinguished information assets. We are assuming that for each feature $\omega \in \Omega^{PI}$ there is a specific set A_ω^{PI} of possible realizations of feature a_ω.

It is assumed that the purpose of the information assets subsystem is to obtain information assets showing the desired functional properties. These information assets constitute inputs provided as a service. Services are provided to platform users – integrated IT systems.

Elements of the information processing subsystem within the integration platform are activated portions of information numbered $p \in P(t)$, called also information assets. Relations between activated information assets make up various functional configurations.

The purpose of the information processing subsystem is to bring information assets to desired states $\overset{*}{\alpha}_p$. within time interval $\Delta \overset{*}{T}_p$. Certainly, initial state α_p^0 at time point $t_0 < t$ differs from the desired one. In order to achieve the desired state, the IP needs to provide the possibility of performing information processing, to bring information from state α_p^0 to state $\overset{*}{\alpha}_p$.

Let us assume that at the stage of IP designing, a standard process of information processing was defined, which covers all possible types of information assets belonging to set P. From the perspective of individual asset types, this process can be divided into types and their relevant objectives.

Individual process types are numbered by variable $b = \overline{1, B}$. Each process type determined by pair $\langle a^b, t \rangle$ is characterized by an initial and a final state.

When analyzing the processes of the actual information assets processing against the standard process types, for each information asset type a set of intermediate processes can be identified together with their related intermediate objectives and standard functional configurations. The intermediate processes should be performed in a pre-defined sequence, in order to achieve:

1) a state, which is desired from the informational and/or functional point of view,
2) a pre-defined level of functional security of the information asset.

Assuming that for each information asset of type $b \in B$ an initial and a final number of stage of a b-type process is specified and assuming that achievement of an intermediate objective with a higher number is determined by achievement of an objective with a lower number, then for each information asset type a sequence of numbers of b-type process stages can be determined, as well as a corresponding sequence of standard functional configurations, realization of which ensures achievement of the intended goal in both the functional and the security aspect. From the perspective of security management, the sequence (e.g. for a b-type information asset) can be represented as follows:

$$K^b = \{1, 2, 3, 4, \ldots K_b\}. \tag{2}$$

3.2. The functional configuration

Let us introduce the following notation of a functional configuration:

$$KF_{kl} = \left\langle Z^{kl}, O^{k}, ZT^{l} \right\rangle \tag{3}$$

where:
Z^{kl} – a set of information processing tasks that can be handled by the kl[th] functional configuration,
O^{k} – a set of functional assets engaged in performing tasks from set Z^{kl},
ZT^{l} – a set of technical assets in good working order, used for "calling up" the kl[th] functional configurations.

The fact of knowing functional configuration KF_{kl} offers an opportunity to assign to each set Z^{kl}, with set ZT^{l} determined, a corresponding set O^{k}. Functional configuration KS_{kl} is workable if and only if set Z^{kl} with determined elements of set ZT^{l}, can be assigned such a set of functional assets O^{k}, which will ensure performance of tasks set Z^{kl}.

4. The security control subsystem

4.1. Agent

It is assumed that the purpose of the security control subsystem operation is to maintain the current security level required for the Integration Platform. This purpose can be achieved through on-going control of the functional security configurations.

The security control subsystem comprises the following elements:

1) a decision-making agent – an element of automated generation of control decisions or the Organization's Security Forum,
2) a set of control decisions (directives) activated by the decision-making element.

Moreover, the security control subsystem includes the following additional elements:

1) a team appointed to design various types of security configurations, whose task is to prepare a set of assets-related proposals for security configurations, based on the specification of the integration platform security requirements and the corporation's approved security policy,
2) a team appointed to review the effectiveness of controls activated in the integration platform's information processing subsystem,

3) a team dedicated to operate security controls, whose task is to reinstate controls operability in cases where vulnerabilities and/or weak points have been found in the course of operation,
4) a team dedicated to record and control any potential physical, technical, software, procedural and organizational controls.

4.2. The functional security configuration

The term of functional security configuration represents an adequately designed and implemented set of controls with pre-defined security functions. Each security function is performed in a precise manner, under pre-defined conditions of a real threat and vulnerability and at a specified time in the integration platform environments. The precision of this operation determines the information assets security and in consequence – security of the integration platform.

A set of the integration platform potential security configurations can be defined as follows:

$$\{KB_p = \langle zi_p, AB_p, MB_p \rangle; p \in P\} \tag{4}$$

where:
$zi_p \in ZI$ – the p-th information asset, for which the functional security configuration has been generated;
$AB_p \in 2^{AB}$ – a set of security attributes assigned to the p-th information asset;
$MB_p \in 2^{MB}$ – a set of security controls creating the p-th functional security configuration;

Knowing:

set $ZI(t)$ of information assets being currently processed in the integration platform's information processing subsystem,

sets $MB_p(t)$ of security controls currently available for each information asset being currently processed,

current values $ab_p^h(t) \in WAB_p^a$, $h \in H$, $p \in P$ of security attributes for each information asset,
where:
H – a set of numbers of the security attributes names,
WAB_p^h – a set of permissible values of the h-th attribute of the p-th information asset,
we are able to identify the current level of the integration platform's functional security and to control it thereafter.

Let us introduce the following designations:

D – a set of permissible control decisions, hereinafter referred to as directives, which can be used by the Security Forum members to determine current properties of security controls,

V_d – a set of pairs corresponding to these controls:

$$\langle k,l\rangle \in K \times L \tag{5}$$

where:
K – a set of security configurations numbers,
L – a set of numbers of the security configurations distinguished;
$\underline{c(t)}$ – a vector the security configurations distinguished state, the co-ordinates of which determine the states of security configurations for individual information assets at moment t.

The concept of state $c^k(t), k \in K$ of the k-th security configuration represents a vector of characteristics describing its current security properties:

$$c_k(t) = \left(c_l^k(t) \in C_l^k : k \in K, l \in L\right) \tag{6}$$

where:
$c_j^k(t)$ – co-ordinates of the vector of the k-th security configuration state, representing individual characteristics of security.
C_j^k – a set of permissible realizations of the security configuration's l-th characteristic,
L – a set of numbers of configurations' distinguished characteristics.

The impact of decisions made by various functions in the company on the current state of security configuration at moment t, can be presented as follows:

$$\bigwedge_{\langle k,l\rangle \in K \times L} c_l^k(t) = c_l^k[d(t)], d \in D \tag{7}$$

As a result, a set of security configurations, the current state of which (and consequently – the current properties of IP's security) can be determined by the Security Forum members, can be defined as follows:

$$\overline{KB} = \{kb_k \in KB: \bigvee_{l \in \bar{L}} [\langle k,l\rangle \in V_D], k \in K\} \tag{8}$$

From the perspective of the possibility to control the integration platform's current security properties and to process information assets within the platform, each security configuration can be described in an extended way as follows:

$$k\bar{b}_k = \left\langle zi_k^p, AB_k^p, MB_k, D_k, rs_k^p \right\rangle, k \in K, p \in P \tag{9}$$

where:
zi_k^p – name of the p-th information assets, for which the k-th security configuration was selected,
AB_k^p – a set of security attributes assigned to the p-th information resource, for which the k-th security configuration was selected,
MB_k – a set of controls incorporated in the k-th security configuration,
D_k – a set of control decisions (directives) required to generate the k-th security configuration,
rs_k^p – residual risk value for the p-th information resource following application of set MB_k of security controls.

Let us remind that the purpose of the security control subsystem is to call up within time period $\Delta \overset{*}{T}_p$, a set of configurations numbered $k \in K(t)$, ensuring achievement of the required values $ab_p^b(t) \in WAB_p^b$, $b \in B(t)$, $p \in P(t)$ of security attributes for each information resource being currently processed.

5. Loss of the integration platform functional security

Loss of integration platform's functional security is understood as an event occurring at moment t_i, caused by a difference between the desired level of the IP's functional security and its current functional security level. An event like this is interpreted as "loss of security level" at moment t_i.

This corresponds with condition:

$$Z^P(t_i) \supset Z^B(t_i) \tag{10}$$

where:
$Z^P(t_i)$ – a set of information processing tasks required to be performed by the information processing subsystem until moment t_i, resulting from requests for services received from users until moment t_i,
$Z^{PB}(t_i)$ – a set of information processing tasks feasible in the information processing subsystem with the current functional configuration and the current security configuration.

The space of possible types of IP security loss is determined by the Cartesian product:

$$A = 2^Z \times 2^{KF} \times 2^{KB} \times 2^{DS} \tag{11}$$

where:
Z – a set of information processing tasks feasible in the IP's information processing subsystem,
KF – a set of possible functional configurations
KB – a set of IP's possible security configurations,
DS – a set of permissible control decisions.

Element:

$$a_{pvud} = \left\langle Z_p, KF_z, KB_u, DS_d \right\rangle \tag{12}$$

defines the type of IP functional security loss. Let us assume that for each security loss type, the value of function defining the functional security loss number is specified

$$\lambda(pzud) = v \in N \tag{13}$$

It is assumed that the integration platform is fitted with:

a subsystem of automated operability control and a diagnostic software unit detecting all types of emergency situations,

an automated functional security control subsystem and a diagnostic software unit detecting all types of security loss.

In order to identify the situation – functional security loss – explicitly, the IP security control subsystem will be using the following identification functions:

a set of information processing tasks

$$F_Z : A \to Z, f^Z(a_v) = Z_p \tag{14}$$

a set of functional configurations

$$F^{KF} : A \to 2^{KF}; f^{KF}(a_v) = KF_Z \tag{15}$$

a set of security attributes

$$F^{KB} : A \to 2^{KB}, f^{KB}(a_v) = KB_u \tag{16}$$

a set of permissible control decisions – directives

$$F^{DS} : A \to 2^{DS}; f^{DS}(a_v) = DS_d \tag{17}$$

Moreover, it is assumed that for each type $a \in A$ functional security loss categories numbered v, and sets Z_P, KF_Z, KB_u, DS_d are finite and determined at the stage of IP design.

6. The re-configuration function

In order to provide an opportunity to compensate for loss of the required security level, it is required to determine at the stage of IP design a set of permissible control decisions, hereinafter referred to as directives, which can be used by the corporation's security team members to determine such current properties of security configurations, which ensure achievement of the IP required security level. IP's transition from the "no required security level" status to the "required security level achieved" status can be described by means of the following representation:

$$FR: KF \times KB \rightarrow KF \times KB \quad (18)$$

determined in the following way:

$$FR(KF^v, KB^v) = (KF^w, KB^w); w, v \in N, w \neq v \quad (19)$$

where:
KF^v, KB^v – respectively, a set of permissible functional configurations and functional security configurations prior to emergency situation numbered $w \in N$,
KF^w, KB^w – respectively, a set of permissible functional configurations and functional security configurations following emergency situation numbered $w \in N$.

This representation is determined at the stage of IP design, in order to ensure achievement of the desired functional properties in IP operation as well as achievement of the desired functional security. The desired functional property can be achieved by means of generating an appropriate functional configuration from the set of permissible solutions, whereas the desired functional security can be achieved by means of generating an appropriate security configuration from the set of security configuration permissible solutions.

Conclusion

When using or planning to use an integration platform that would retain its interoperability and the required capacity, organizations are facing complex problems of controlling the platform current functional properties and ensuring its functional security. Functional security of an integration platform is an element of organization's overall security and depends on the correct operation of integrated IT systems in response to inputs (services requested by these systems users).

The integration platform's functional security is achieved through building in specialized security configurations into the platform, to provide input-based security control. The security function's certainty and quality is determined by the functional security and failure-induced risk reduction requirements.

The integration platform risk can be reduced down to an acceptable level through relevant technical and organizational measures (figure 2).

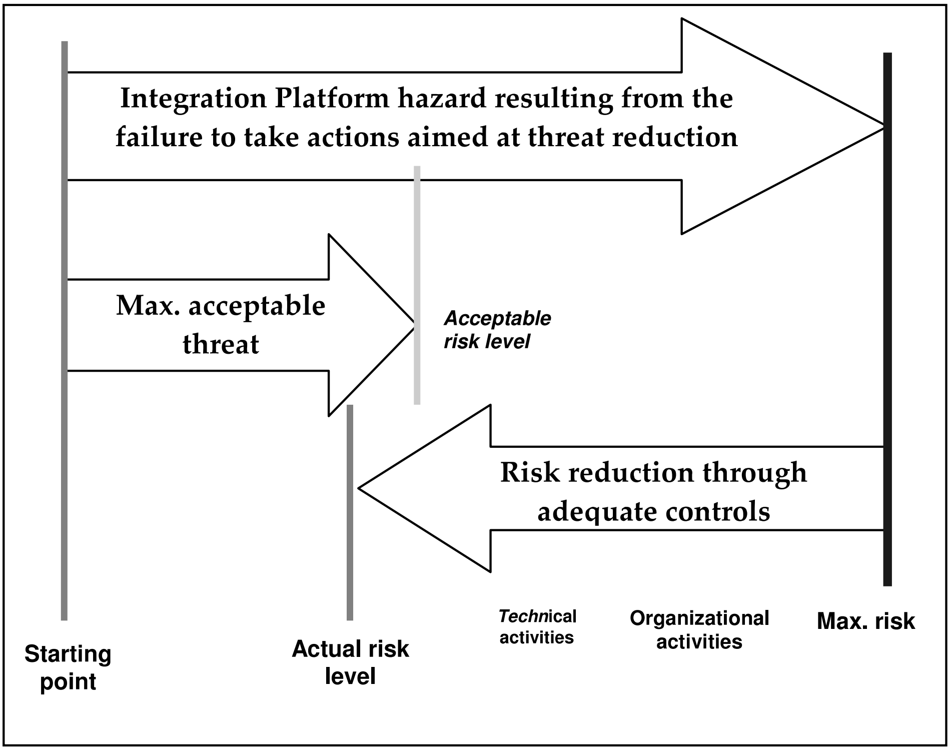


Figure 2. Illustration of the functional security principle

Source: Own elaboration.

For the purpose of implementing a process intended to maintain the required level of functional reliability, it is possible to develop a software (operational elements) that would provide automated control the integration platform functional properties, in order to balance out (tolerate) emergency situations.

The considerations discussed in the present chapter lead to following conclusions:

1. In order to eliminate the impact of emergency situations on the integration platform operation, it is justifiable to distinguish two phases:
   a) identification of a set of functional configurations permissible for the given emergency situation,
   b) selection of a (e.g.: permissible, optimal or suboptimal) functional configuration for the given emergency situation.
2. At the software level, the proposed methodology of controlling the integration platform's functional properties should be integrated with the platform's system software.
3. The proposed model of ensuring functional security can be used at the conceptual stage of developing new integration platforms.
4. The integration platform's functional security is achieved through building in specialized security configurations into the platform, to provide input-based security control. The security function's certainty and quality is determined by the functional security and failure-induced risk reduction requirements.

The chapter does not provide any ready-to-use "formula" that would ensure integration platforms security. It should be regarded as the author's proposal how to partly solve the problem of establishing an Information Security Management System that would ensure the required security of integration platforms. The approach to security proposed here addresses the problems encountered by corporations using integration platforms and is a result of the author's findings and several years of experience from:

a) observing the process of establishing and implementing such systems in corporations,
b) studies and research work, as well as seminar discussions on the corporate security issues.

References

1. Górski T. (2012), *Platformy integracyjne. Zagadnienia wybrane*, Wydawnictwo Naukowe PWN, Warszawa.
2. Stanik J. (1987), *Utrzymywanie wymaganego poziomu bieżącej niezawodności funkcjonalnej komputerowego systemu zautomatyzowanego dowodzenia*, a doctoral thesis, Warszawa.
3. Stanik J. (2012), *Zagadnienia bezpieczeństwa platformy integracyjnej*, in: Górski T., *Platformy integracyjne. Zagadnienia wybrane*, Wydawnictwo Naukowe PWN, Warszawa.

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Chapter 4
Evaluation of eGuides: a discussion of approaches

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Introduction

Museums and other places which are home of cultural or natural heritage exhibits try to attract their visitors in various ways in order to make their stay at the museum more interesting and worth recommendation. One of the possible solutions which can certainly make the visit more attractive, especially in the technology dominated world will live in, are eGuides – multimedia visitor guidance systems.

Introducing eGuides in a museum is a complex process that includes purchasing the devices with all additional hardware and software, preparing and producing the content, making necessary organizational changes, and introducing the eGuides to the public.

There are various technical, content-related and people-related issues that need to be addressed if the eGuides are to be introduced successfully [Linge et al., 2012, pp. 67–82]. Certainly, a feedback from users could shed a lot of light on what should be improved.

In this chapter we would like to discuss possible approaches to how, technically, such feedback could be obtained. We base our ideas and opinions on actual experiences with evaluation of eGuides during the ongoing development of the BalticMuseums 2.0 Plus project.

The main aim of this project, titled "Implementation of eGuides with cross-border content for South Baltic Oceanographic Museums", is to develop and implement a system to efficiently share multilingual content and present it to museum visitors using multimedia visitor guidance system (eGuide), and so enhance the attractiveness of the museums. The project is realized by an international consortium consisting of two scientific institutions – the University of Applied Sciences in Stralsund and the University of Szczecin, and four oceanographic museums – The German Oceanographic Museum in Stralsund, Gdynia Aquarium, Lithuanian Sea Museum in Klaipeda and the Museum of the World Ocean in Kaliningrad, with the financial support from the European Regional Development Fund within the South Baltic Programme 2007–2013 [*BalticMuseums 2.0 Plus...*, 2011].

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1. A brief look at eGuide technology

The eGuide technology, as its name suggests, is supposed to substitute human guides with electronic devices capable of communicating information about visited places and watched objects to visitors. Thus, like human guides, eGuides can serve roles of pathfinder and mentor [Wecker et al., 2011].

Although implementing eGuides in a museum requires considerable investments in hardware, software and content creation, in the long term they are economically attractive, compared to real guides' wages.

The core eGuide functionalities resemble earlier audio guides (see e.g. [Christensen, 2011, pp. 17–18]). They include:

- earphones that help avoid tourists or tourist groups to intrude each other's tours,
- multiple language versions that let foreign visitors get the same tour experience as the local visitors do,
- tour personalization, i.e. allowing tourists to choose individual route and pace of their tour,
- tour specialization, e.g. for children or disabled people.

However, eGuides offer much more than that. They have high resolution color displays allowing for hypertext descriptions of objects and multimedia presentations. They may often have touch panels allowing high level of presentation interactivity, cameras that can be used to identify objects, and GPS receivers or WiFi adapters that help determine visitor's location [Petrie, Tallon, 2010].

The WiFi adapters offer additional eGuide functionalities, such as automatic updating of the content, access to extended descriptions and presentations augmented with content from the Web, coordination of group tours, and communication among tourists from the same group (see e.g. [Wermers et al., 2011]).

2. Evaluation of eGuides: reasons, range and aims

After making the eGuides available to the public, the visitors' satisfaction with the solution should be studied, evaluation of the results carried out, and, if necessary, modifications and improvements should be introduced.

The satisfaction of the visitors with the eGuides can regard the following aspects:

- presented content (is it interesting, not too long, comprehensible, etc.),
- communication and display style (are texts/images/videos clearly visible, is the size/contrast/sound adequate),
- navigation style (is navigation comfortable and intuitive),

- interaction with the surroundings (does the device make the stay in the museum more attractive, does it complement knowledge without interfering with the tour).

By carrying out appropriate research one can determine:

- whether the content developed for eGuides is properly designed for specific categories of visitors,
- if the developed tours are free of technical defects (regarding visual aspects, sound quality, navigation, and links to real specimens in the aquarium/museum),
- whether the used equipment is ergonomically designed for users (headphones, access to equipment, the use of the device),
- whether the different language versions are well appraised by foreign visitors.

In order to get answers to the above-mentioned issues, a questionnaire-based survey can be carried out.

3. Techniques of questionnaire-based evaluation

Questionnaire is "a set of carefully designed questions given in exactly the same form to a group of people in order to collect data about some topic(s) in which the researcher is interested" [McLean, 2006].

Questionnaires may contain both closed-ended and open-ended questions [Babbie, 2010, p. 256]. The former include a list of predetermined answers, the latter let participants answer in their own words. As a result, while the answers to open-ended questions are more difficult to analyze, they can be useful when the possible answers to questions are not clear or for gathering insightful or unexpected information.

The questionnaire-based survey can be performed in various ways. Not every such technique can be effectively applied to the evaluation of eGuides in museums. For this reason, in this section, we shall only discuss those that seem appropriate for this purpose.

We can classify the techniques according to two factors: the means of administering question (text or interviewer) and the medium of recording response (paper or computer).

In the case where the interviewer administers the questions, we can either use a PAPI (paper and pencil interview) or a CAPI (computer assisted personal interview) method of survey [Beam, 2012, pp. 136–139]. The main advantage of both these methods is the feasibility to include a wide range of questions, obtain more comprehensive and in-depth answers, and have a chance to ask some follow-up questions. An additional advantage in case of CAPI is that the data is directly in electronic form. Yet both mentioned methods are appropriate in case of a single, rather small scale survey. For more frequent surveys, or surveys involving a big sample of interviewees, such methods could be burdensome (both for the surveyed persons and pollsters) and costly.

For the text means of administering questions, the following methods were taken into consideration: a self-administered questionnaire (SAQ) [Wolf, 2008], when the respondent delivers the answers on paper, and computer-assisted self-interview (CASI) [Olsen, Sheets, 2008], when providing answers by the respondent is computer-assisted. These methods can however be less useful than the interviews as there is no chance of clarifying or explaining anything to the respondent, which often results in lower answer rate, or asking any follow-up questions. There is also a lower chance to get answers to open-ended questions [Beam, 2012, p. 145, 156, 173]. But there are also advantages of self-administered questionnaires. In both cases more privacy is guaranteed for the surveyed persons, which may result in more frank answers, especially in case of questions regarding likes or dislikes or sensitive matters [Beam, 2012, p. 139].

The CASI method, realized in a form of a short questionnaire included at the end of the tour (to be answered by the visitor on the eGuide device itself, which serves here the role of computer), seems a good solution for continuous monitoring of visitors' opinions regarding eGuides. In this way much more visitors can be surveyed and foreigners have a possibility to answer in the language of their choice. This solution has however a few constraints. The number of questions must be limited to only a few, so that it is more likely that the visitor will provide the answers. Only closed-type questions can be used, so that the visitor does not need to write anything but just choose from a set of possibilities or rates. This solution is also the most technically demanding: the survey software has to be implemented and embedded within the tour, and the process of automatic data collection has to be developed, so that the survey results need not be retrieved from the devices manually.

Having decided on the means of administering question and the medium of recording response, one can proceed to prepare the questionnaire content, that is questions, answers (for closed-ended questions), and their order. In the following section we shall describe the course of preparation and content of questionnaires for eGuide evaluation in the BalticMuseums 2.0 Plus project.

4. Questionnaire preparation and content

It was agreed with the museum partners that the survey for primarily evaluating the eGuides will be done using PAPI or CAPI method. In case of foreigners they would be asked to fill the questionnaire by themselves using the questionnaire prepared in the language of their choice (SAQ). It was decided that museums will prepare the questionnaires in their national language, in English and in all other languages the tours are available in.

The other possible method, for continuous monitoring of visitors' opinions regarding eGuides, described in the previous section – CASI, was taken into consideration for future application.

The set of questions for the questionnaire was prepared on the basis of similar questionnaires used by other museums and institutions where audioguides or eGuides were used and evaluated, and supplemented with questions corresponding with the needs and characteristics of the museums taking part in the project. The questions contained in the questionnaire concerned:

1) expectations of the visitor regarding the eGuide,
2) visitors' opinion about the proposed content,
3) visitors' opinion about the technical aspects,
4) some other general information.

Figures 1–4 present some example questions included in the questionnaire regarding each of the above mentioned aspects.

1. **What were your expectations of the eGuide?**
   a) to get an overview of the exhibitions
   b) to get more detailed information
   c) to have less texts to read
   d) to get information in my own language
   e) to have a chance to get familiar with the new iPod
   f) other: ……………………………………………
2. **Have your expectations been fulfilled?**
   a) yes
   b) partly, *[explain]* ………………………
   c) no

Figure 1. Example questions regarding expectations of the visitor
Source: Own elaboration.

1. **How would you rate the content of the eGuide overall?**
   a) very good
   b) good
   c) average
   d) not so good
   e) very poor
2. **What content of the eGuide did you like and/or dislike**

likes	dislikes

Figure 2. Example questions regarding eGuide content

Source: Own elaboration.

1. **How did you cope with the iPod?**
   a) have you ever used an iPod before?
      a. yes
      b. no
   b) was the explanation given at the counter sufficient?
      a. yes
      b. no
      c. there was no explanation
   c) did you have problems with operating the device?
      a. yes
      b. no
      c. partly
   d) did you have to ask for help?
      a. yes
      b. no
   e) did you have any other technical problems?
      a. yes, *[explain]* ………………………………….
      b. no
2. **Did you have difficulties finding the numbers/objects in the exhibition?**
   a) yes, *[explain]* ……………………………………..
   b) sometimes
   c) no

Figure 3. Example questions regarding technical aspects

Source: Own elaboration.

1. **How would you rate the selected language version of the eGuide?**
   a) very good
   b) good
   c) average
   d) not so good
   e) very poor
2. **Would you use the eGuide again?**
   a) yes, *[explain]* ....
   b) no, *[explain]* ....

Figure 4. Example questions regarding general information about eGuides
Source: Own elaboration.

Apart from preparing the questionnaire an important aspect related to carrying out the survey was defining the range of research – population, area, time limits and sample size. In this case the population constitute the museums' visitors using eGuides during their visit, the area is limited to museums' premises in Stralsund, Gdynia and Klaipeda and the time frame includes two periods of 60 days – one in summer (high season) and another in winter (low season). Due to museums' limited personnel, time and budget possibilities the number of respondents to be surveyed in each survey, was limited to 200 and to three subgroups: adults, school children, and elderly persons.

5. Alternative approaches to eGuides evaluation

If the museum visitors' opinion survey was an ongoing process, it would allow museums to have up-to-date information on the clients' feelings about the eGuides and in this way be able to react whenever visitors become dissatisfied. As the survey methods are not suitable for mass and frequent application, alternative methods of evaluation should be considered.

There is a solution offering a possibility to survey all eGuide users, without any effort from their side, or without any interviewers involved. The solution is to use an in-built monitoring software that would anonymously collect information about users' operations on the device. Such survey method gives an opportunity to collect information otherwise impossible or difficult to obtain, e.g.:

- which parts of the tour were skipped,
- at which points of interest the tourists spent most time,
- was a particular multimedia presentation viewed until its end, or stopped,
- which elements of eGuide user interface were used frequently and which were ignored.

Moreover, by collecting basic statistical data (e.g. age and sex) when renting a device, and combining it with eGuide monitoring results, one can obtain a good deal of useful information on how specific classes of visitors tour the museum.

In this case however we also face the technological issues regarding obtaining, installing and executing such monitoring software on the devices and analysis of the collected data, which may amount to a considerable volume.

It must be clearly stated, though, that by merely analyzing monitoring data one cannot answer many types of questions, including those as simple as 'did you like the tour with an eGuide or not?'. So, the best solution would be to use the different approaches combined.

Conclusion

The eGuide technology offers an opportunity to improve tour impressions for the visitors at the same time being economically attractive for the museums. The improvement, however, can only be attained if the eGuides are implemented in a right way. This in turn can hardly be accomplished without a feedback from the visitors (see section two for a list of what can be learned from them).

A simple and efficient method of eGuide evaluation is by using questionnaires. It is possible to administer them in an assisted (PAPI/CAPI) or unassisted way (SAQ/CASI), as well as using computer-supported (CAPI/CASI) or traditional approach (PAPI/SAQ). In our opinion, the choice of the actual technique should be done considering both technical limitations and the nature of information to be obtained.

There is also an alternative to questionnaire survey, feasible thanks to technological sophistication of eGuide devices: monitoring software which would anonymously collect data concerning how visitors use the eGuide. It allows for an ongoing, nearly effortless, and precise recognition of the visitors' preferences, and help the museums refine the content or other aspects of eGuides to achieve higher visitors' satisfaction. Still, it requires higher initial investments, and cannot answer many of the questions that questionnaires could.

References

1. Babbie E.R. (2010), *The Practice of Social Research*, Wadsworth/Cengage Learning, Belmont.
2. *BalticMuseums 2.0 Plus. The Project* (2011), http://balticmuseums.org/plus-the--project.html, accessed 27.02.2013.

3. Beam G. (2012), *The Problem with Survey Research*, Transaction Publishers, New Brunswick.
4. Christensen J. (2011), *Four steps in the history of museum technologies and visitors' digital participation*, "MedieKultur. Journal of media and communication research", Vol. 50.
5. Linge N., Bates D., Booth K., Parsons D., Heatley L., Webb P., Holgate R. (2012), *Realising the potential of multimedia visitor guides: practical experiences of developing mi-Guide*, "Museum Management and Curatorship", Vol. 27, iss. 1.
6. McLean C. (2006), *Questionnaire*, in: Jupp V. (ed.), *The SAGE Dictionary of Social Research Methods*, SAGE Publications, London.
7. Olsen R., Sheets C. (2008), *Computer-Assisted Self-Interviewing (CASI)*, in: Lavrakas P.J. (ed.), *Encyclopedia of Survey Research Methods* , SAGE Publications, Thousand Oaks.
8. Petrie M., Tallon L. (2010), *The IPhone Effect! Comparing visitors' and museum professionals' evolving expectations of mobile interpretation tools*, in: Bearman D., Trant J. (eds.), *Museum and Web 2010: Proceedings*, Archives & Museum Informatics, Toronto.
9. Wecker A.J., Kuflik Ts., Stock O. (2011), *Group navigation with handheld mobile museum guides*, in: Trant J., Bearman D. (eds.), *Museums and the Web 2011: Proceedings*, Archives & Museum Informatics, Toronto.
10. Wermers M., Herkenrath G., Borchers J. (2011), *GroupAixplorer: An Interactive Mobile Guide for Small Groups*, in: *CHI '11: Extended Abstracts on Human Factors in Computing Systems*, ACM Press, New York.
11. Wolf J. (2008), *Self-Administered Questionnaire*, in: Lavrakas P.J. (ed.), *Encyclopedia of Survey Research Methods*, SAGE Publications, Thousand Oaks.

Abbreviations

PAPI – Paper And Pencil Interview
CAPI – Computer Assisted Personal Interview
CASI – Computer Assisted Self Interview
SAQ – Self-Administered Questionnaire

Chapter 5
Strategic advantages of integrated information system implementation: case study of Urban Mass Transportation

Andrzej Kamiński

Introduction

The system of ERP class (Enterprise Resource Planning) is an integrated, highly effective and accessible information system. The system was developed to meet the needs of integrated industrial establishment management. Being constantly improved and evolved, the system of ERP class has become the most popular tool for production planning and control in large-scale and medium-sized enterprises (70% of computerized industrial establishments in Western Europe base its business activity on the information systems developed according to MRP standard). ERP covers the entirety of production and distribution processes, integrates different enterprise activities, rationalizes important information flow and allows to react on shifts in demand. These information is constantly updated (in real time) and available at decision point (for on-line systems).

Implementation of the integrated information system allows to eliminate redundant data and significantly reduce the number of errors, being a result of multiple input of the same data by different employees. Moreover, it allows to implement a separate configuration for processes, based on complete system evaluation.

The enterprises delaying integrated system implementation sustain calculable losses related to upkeep and service of different computer systems and applications. The losses ensue from the following:

- the need of periodic purchase of actualized versions of packages and program products, upgraded systems and databases, additional software (i.e. database drivers, class libraries and procedures),
- the inability of rational planning of working hours and responsibilities of IT specialists (there is a need to hire experts for maintenance and development of separate strategic applications, while its implementation tools belong to the product group from the market niche),
- high costs related to interface development and maintenance between separate subsystems created with different information technologies by independent groups of IT specialists, project engineers and software specialists.

On the other hand, implementation of integrated information system for enterprise management allows to obtain calculable economic benefits, such as:

- cost reduction by elimination of redundant data, decreasing the number of operational activities in management implementation process and automatization of material assets control procedures,
- better activity management and implementation of new methods of quality management according to ISO 9000 and ISO 14000 standards,
  according to applied procedures and system logic,
- procedure and function integration, source documents unification and development of documentation for management procedures (circulation of documents, authority check for information access, archiving regulations),
- on-line access to actual economical information, current analysis of selected economic indicators (i.e.: solvency, commercial viability, stock levels, financial settlements),
- active debts and indebtedness control, implementation of customers control and payment monitoring (order processing suspension in case of payment delays – possibility to settle individual customer credits and terms of payment),
- stock control, stock displacements, automatic monitoring of stock and raw materials level, information about the necessity of stock replenishment.
- implementation of management information system, possibility of multicriteria analysis of financial and operational data [Ptak, 2004; Ferran, 2008; Wallace, Kremzar, 2001].

Investment in the software of MRP/ERP class could contribute to enterprise productivity, effectiveness and competitiveness. Expected return on investments is a key element for the decision about the implementation of a new information system. A company implementing ERP system can expect profitability and turnover increase on one hand and stock reduction on the other. Unfortunately, it happens that the new system doesn't meet company needs. Modern solutions could positively influence many key activities: production, sales, bookkeeping and customer service but there is a need of broad preparations before system implementation. Installation of individual modules and components doesn't guarantee that procedures, functions and exact data would be maintained and good coordination of planning, control, production and distribution would be provided. Despite modern system implementation excessive stock, delays in deliveries and huge differences between planned and real turnover could appear. To minimize the risk of side effects it is necessary to make a branch characteristic and then define company's mode of operation, its needs and obligatory functionalities.

Integrated information system implementation should be strongly correlated with reorganization methods. In the implementation process of MRP/ERP class systems it is important to find a compromise between package functionality and its susceptibility to changes and modifications versus needed reorganization in the company. At the present moment, the technology of modern integrated systems development allows to conform them with specific company needs. However, it is important to remember that implementation, test, documentation and service costs have a huge influence on project budget. All changes in standard software design increase the risk of failure.

The choice of the specific information system of ERP class is undoubtedly a complicated decision. Key element of the implementation process is a reconstruction of economic processes in order to optimize the methods of workflow management and material resources flow. The results of the integrated economic analysis should meet reorganization and information needs of the company and define the functionalities and technological design of ERP package. It is important to mention, that mistakes made during preliminary analysis cumulate and often could be identified only during the acceptance test of particular modules which can lead to delays and end up with unexpected and unplanned changes.

Particular attention should be paid at the integrated system scale. The choice of operation environment, database platform and system design should guarantee error-free operation regardless of load. Data conversion process expressed in the number of generated documents could only be limited by technical parameters of the servers and workstations and not by system software design. In other words, system should work efficiently both generating 10 000 and 100 000 documents per month. System speed should only be limited by technical capabilities of the equipment.

1. The analysis and benefit assessment of the implementation of the integrated system for human resources management in the Urban Mass Transportation Company (MPK)

The objection of the project was the implementation of the integrated system for human resources management in the Urban Mass Transportation Company (MPK).

The project was covering two domains: operational and strategic.

- operational – company employees get benefits of automatization process, for example: the input of source documents (only once), access to system functions, dedicated to certain activity.
- strategic – the company management can evaluate financial condition of the enterprise, control stocks and material resources, plan rational activities in hu-

man resource management, wage policy, improve and develop personnel qualifications, intervene in case of irregularities.

The project of the implementation of the integrated system for human resources management would enclose the following phases: system analysis, implementation of the module supporting the central human resources filing system and integration with financial and accounting system. The results of the analytical work will be skipped in the following part of the chapter. At the same time, the operational and strategic benefit description will be provided.

Phase I – central human resources filing system and administration

First phase (the base) is the implementation of the central human resources filing system including personal data, competence and authorities, invariable wage and salary information and professional activities (employment, dismissals, absences, sick leaves, holidays etc.). Material effect of the 1st phase should be the implementation of the integrated information system for human resources management (with a central database) on the operating (access to current information regarding each employee and his back files) and management level (automatic reporting and statistics about chosen professional groups). The access to particular categories of personal data would be realized according to the role and authority scheme. The integrated system will meet the requirements of the "Act on Fair Information Practices and Personal Data Security". Taking into consideration that MPK doesn't have the central database of employees and professional activities, the benefits after the implementation of the 1st phase should be the following:

1. On operational level:
   - The adjustment and centralization of the professional information, elimination of redundant data (the consequence of multiple data input), access to personal professional data from every terminal station working in the corporative network of MPK with maintenance of login and authority procedures. The filing system of basic personal data of the employee and other professional information (professional qualifications, authorities, medical testing, courses and trainings etc.).
   - The implementation of standard procedures and software solutions which guarantee the personal data processing and archiving security. At the present moment the application technology in MPK is out of date, the personal data are spread, and disintegrated. The minimum data security is not guaranteed. For example, the utilization of MS Office application for personal records (around 300 white-collar workers of the front office) doesn't allow to implement the basic mechanisms of authority and access control. Moreover, there is a lack of elementary file protection which creates a real threat of personal data theft or illegal data copying. Another example is

a manual wage information transfer to the "Payer" program. The drivers' current wage information is copied manually to the program. The data are taken from local servers of MPK subsidiaries (depots) and manually scaled and copied to the "Payer" program. This process doesn't meet minimum security standards, generates high costs, needs the correctness control of the transferred data (two employees are in charge of the process). It is obvious that integrated information system should eliminate the above mentioned problems, ensure data security and reduce data processing costs.

2. On strategical level:
   - The acquisition of reliable and actual reports about human resources. At the present moment, a lot of work should be done to prepare a simple report about employment structure of MPK, seniority and wages divided between professional groups. One should copy, scale and format the data from various applications. As the data are spread, heterogeneous and in different format, the process is laborious (takes two, three days in average). The quality and integrity of manually prepared reports is debatable because multiple manual copying and scaling generates errors. In practice there is no possibility to create reports based on different criteria and make computer prognosis and simulation. It is important to mention that report generator is an integral element of modern top-of-the-range information systems. This tool allows to modify the existing reports and create the new ones using graphical charts of different kind. The access to reports is granted according to possessed authority.

Phase II – wage and salary calculation: integration with financial and accounting system

The implementation of the first phase (integrated system development for MPK human resources management) should allow to centralize the payroll system (second phase) and automatically transfer the error-free data to the financial and accounting system and the "Payer" program.

Payroll job is a relatively simple process which is formed by the sequence of certain steps, such as:

- payroll definition – payroll identification, assessment and accounting period,
- data retrieve from the source (employees and components) based on the payroll template, previous payroll and manual data input,
- fetch of parameters obtained for the moment of payroll creation (based on permanent documents and closed variable documents),
- re-calculation of the components and final payroll check,

– automatic payroll export and accounting (financial and accounting module) based on previously prepared accounting rules.

The payroll system of MPK should guarantee the payroll accounting for basic professional groups. To make it simple, the first professional group should be the white-collar workers, the second one – the drivers and blue-collar workers (service, backup workers, jobbers). The implementation of the integrated payroll system should eliminate disintegration of existing applications and allow fully automatic and error-free data transfer to financial and accounting system and the "Payer" program.

The integrated payroll system will bring the following benefits:

1. On operational level:
   - Regulation and integration of payroll accounting, elimination of redundant data, access to complete and actual professional and payroll information, software parameterizing (permanent and variable salary components for different professional groups), standard authority implementation of payroll operations and transaction security.
   - Reporting to Social Insurance Board (ZUS) – the integrated system provides automatic generation of application forms and account documents to SIB (ZUS) in KDU format. These files could be reviewed and edited in the "Payer" program. In practice, the information about professional group and planned document date should be sufficient to create a declaration. The system automatically checks new employments, dismissals and data change.
   - Reporting to the Tax Office – the system automatically generates and prints tax forms. The system manages the archive of tax declarations. At the present moment tax forms in MPK are generated manually (separately in each department) in co-operation with IT department. The generation of tax forms for front office employees (300 people) engage 3 employees during 4 weeks a year.
2. On strategical level:
   - Cost reduction of data processing as a result of integration and computerization of payroll process, fully automatic data exchange with financial and accounting software and the "Payer" program, co-operation with "Transportation" and "Fleet" systems.
   - Software support in payroll policy development in MPK (taking in consideration that 50% of MPK costs are the salaries, it is recommendable to implement the supporting software, analyzing the payroll structure divided into different wage and salary groups, departments and cost centres). Monitoring of permanent and variable payroll elements, including self-indexation (despite the freeze on the basic salary) in case of new

entitlements of the employees. Examination of correlation between company financial situation, market situation and labor efficiency – linking the payroll to the performance on particular position.

2. The information and integration dimensions of project implementation

The system for human resources management should be open (possible data exchange and integration with other information systems in MPK, especially with financial and accounting system and the "Transportation" system.

In practice the human resources management system is often integrated with an external financial and accounting software: the data are transferred partly/periodically in succeeding accounting periods. The contents and data format should be stipulated for exchange files.

On the other hand, the integration of transportation process including drivers' working schedule and their disposition (taking into account days off, holidays, sick leaves) demands the integration solutions between the human resources-payroll software and the "Transportation" system.

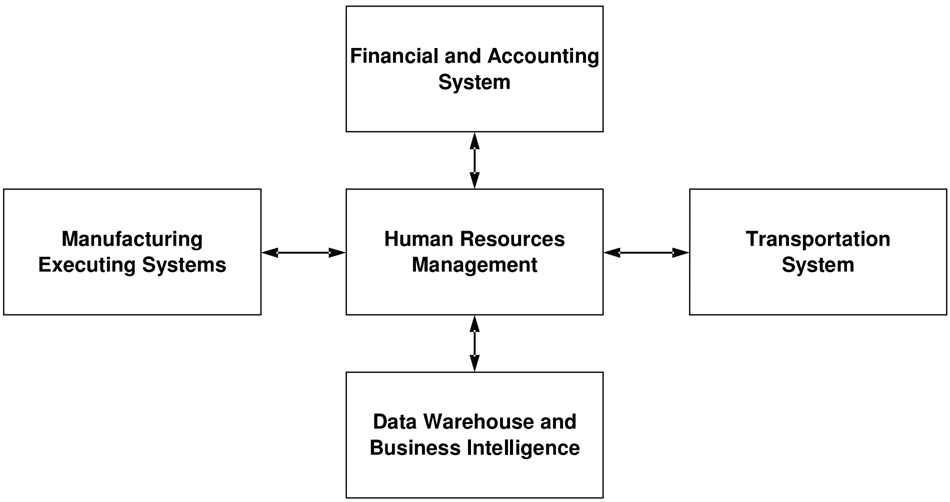

Figure 1. The integration human resources management system with other management information systems of MPK

Source: Own elaboration.

The planned division between domain subsystem supporting the transportation process and human resources / payroll module needs the development of technical project for integration infrastructure and methods and data exchange frequency. In particular, it concerns integration control and data security. While designing the integration solutions one should take in consideration the number of objects and their attributes liable to exchange between particular subsystems and fix the data format and synchronization method.

Conclusion

Global computerization has been started in the national industrial establishments. Before the decision about concrete information solution could be taken, the enterprises should create a strategic plan for company development and computerization. One should remember that mistakes during system analysis and evaluation of concrete ERP class software, inadequate market evaluation of information systems and services, a mismatch of application functionality and technical structure with specific needs of the company could multiply costs of system integration process or even lead to bankruptcy. Taking in consideration high license and consultancy costs, the analysis and future effects prognosis both in operational and strategic dimensions should be an integral element of activities dedicated to preparation of the integrated information system implementation.

References

1. Ferran C. (2008), *Enterprise Resource Planning for Global Economies: Managerial Issues and Challenges*, Information Science Reference.
2. Ptak C. (2004), *ERP Tools, Techniques, and Applications for Integrating the Supply Chain Second Edition*, CRC Press LLC.
3. Wallace T., Kremzar M. (2001), *ERP: Making It Happen The Implementers' Guide to Success with Enterprise Resource Planning*, John Wiley & Sons.

Chapter 6
The models of software quality

Katarzyna Skroban

Introduction

The XX and XXI centuries demonstrated the increasing role of information both in public and private life. Information demand forces the development of modern enterprise computing technologies. Computing technologies implementation becomes very important in the company management pushed through by the rules of free market economy. There are many companies offering information systems and many more customers. Both software customers and purchasers have different view of its quality.

1. Software choice

There is a wide variety of software for the enterprise management support both on Polish and international market. Potential customer needs a lot of time to analyze existing programs to make the right choice. Finally, the purchased software turns out to be unsuitable. Problems with the software choice could have different background:

- purchaser or potential user doesn't have enough knowledge about software present on the market and meeting his needs,
- many purchasers (users) have problems with exact definition of their needs, mainly because of insufficient experience or excessive devotion to the previous software versions,
- not all types and kinds of the software present on the market are suitable for every enterprise,
- many purchasers (users) find it easier to buy computer facilities first; only after that they try to match the needed software,
- there is no standard which allows to rate and match the software; there are many characteristics which define software quality in professional literature, but they are mainly not specified.

The software purchase and software design implementation failed partly or entirely in many enterprises. Usage of unsuitable software could cause many negative consequences for the enterprise, for example:

- cost increase for additional analysis or additional data processing,
- additional time for obtaining the needed information,
- unnecessary software purchase: non-use or limited use of the software,
- possible costs of system recovery,
- possible legal consequences and loss of clients' confidence due to mistakes in software functioning which can end up in company bankruptcy.

Potential negative consequences show the core of the problem connected with adequate software choice and implementation in each company.

2. The software

There are many software definitions in professional literature. One of them treats the software as all utilities present in the computer system and created with the help of software programming languages [Kisielnicki, 2001, p. 71].

According to another definition, the software is a set of statements for computer facilities [Beynon-Davies, 1999, p. 51].

Sometimes software definitions differ depending on purchaser and supplier attitude. According to standard approach the software is defined relative to the final customer. In this context, the software is a specific program product which was developed to meet user needs [PN-ISO\IEC 25000, 2008, p. 11].

2.1. The software classification

The software classification is an important element which influences the evaluation of software quality. The software is usually divided into the system and application software [Kisielnicki, 2001, p. 73]. The system software is called basic and is necessary for computer hardware functionality. The system software realizes the tasks of different users. The system software consists of i.a. operating systems. The application software is a set of programs which implements concrete functions demanded by users.

On the other hand the standard PN-ISO/IEC 25000:2008 [PN-ISO/IEC 25000, 2008, p. 22] educes:

- a business system,
- an information system,
- a software program.

According to another division the software is divided into 4 groups [PN-ISO/IEC 27005, 2010, pp. 37–38]:

- operating systems or programs allowing the start up of all other programs (services and applications); these systems are the base for compatibility of computer hard- and software,

- service, maintenance and administration software or complementary programs for operating system,
- software packages or standard software which complete the general offer (non-dedicated to concrete customer),
- business applications, providing necessary business services and functions to the user.

The user has the biggest influence on the dedicated software, i.e. business applications. According to the distribution method, business applications could be divided as follows:

- heavy duty software, called also "shelf software", bought as a standard software suitable for various users; in [PN-ISO/IEC 25051, 2009, p. 9] this type of software is called commercial-off-the-shelf software product,
- configurable software, maintaining basic functions and customized for the user depending on his needs,
- dedicated software, created to meet the needs of a concrete customer.

Regardless different types of the software, standard methods are used for the software quality evaluation.

2.2. The software quality

Definition of the software quality is a complicated process. It depends on our perspective. The software quality will be evaluated differently by a design engineer, a supplier and an indirect or direct user. For a direct user the software quality depends on program options used to meet his needs and solve his problems. A supplier evaluate the software according to specification conformity. An indirect user will pay attention on the product price. Therefore, unified, measurable and generally understandable characteristics for software quality are difficult to be worked out.

Quality criteria are defined in various methods, norms and publications. These definitions could have significant differences.

According to [PN-ISO/IEC 25000, 2008, p. 23] the software lifecycle phases such as: manufacturing, servicing and usage, are related with quality demands and evaluation criteria (table 1). Quality in use is a set of criteria defined for product evaluation according to the needs of the final user. Demands for external software quality include a set of criteria for technical evaluation. Demands for internal software quality are related to verification criteria on different stages of manufacturing phase. These criteria could be used also for supporting program products, e.g. documentation.

Table 1. Software lifecycle phases and model of quality cycle phases of a program product

Software lifecycle phases	Demands	Product evaluation criteria
Manufacturing	Demands for internal software quality	Internal quality
Servicing	Demands for external software quality	External quality
Usage	Demands for quality in use	Quality in use

Source: Own elaboration based on [PN-ISO/IEC 25000, 2008, p. 23].

Quality model SQuaRE [PN-ISO/IEC 25000, 2008, p. 24] has a hierarchy structure. It consists of characteristics, subcharacteristics and attributes on each level.

Different evaluation criteria are mentioned regarding software or additional software components depending on distribution method.

2.3. The quality criteria

Heavy duty software is purchased and used by mass user. From the user's point of view this type of software is characterized by the following features:
- big number of unnecessary functions,
- deficits in other significant functions.

The quality criteria used for heavy duty software (commercial off-the-shelf product) are derived from the standard PN-ISO/IEC 25051:2009 and consist of following groups:
- criteria concerning software itself (as a product),
- criteria concerning user documentation,
- criteria concerning test documentation.

Quality criteria for software as a product are the following [PN-ISO/IEC 25051, 2009, pp. 15–18]:
- functionality conforming with user documentation,
- reliability connected with error maintenance,
- utility,
- efficiency,
- upkeep,
- portability,
- quality in use.

Most of the models described in professional sources refer to the criteria mentioned above and extend them on additional aspects. McCall model, for example, distinguishes three features: functionality, adjustment possibilities and mobility.

Most of the models of the software quality evaluation have a hierarchy structure aligned as a tree. This kind of structure is shown in the model on figure 1.

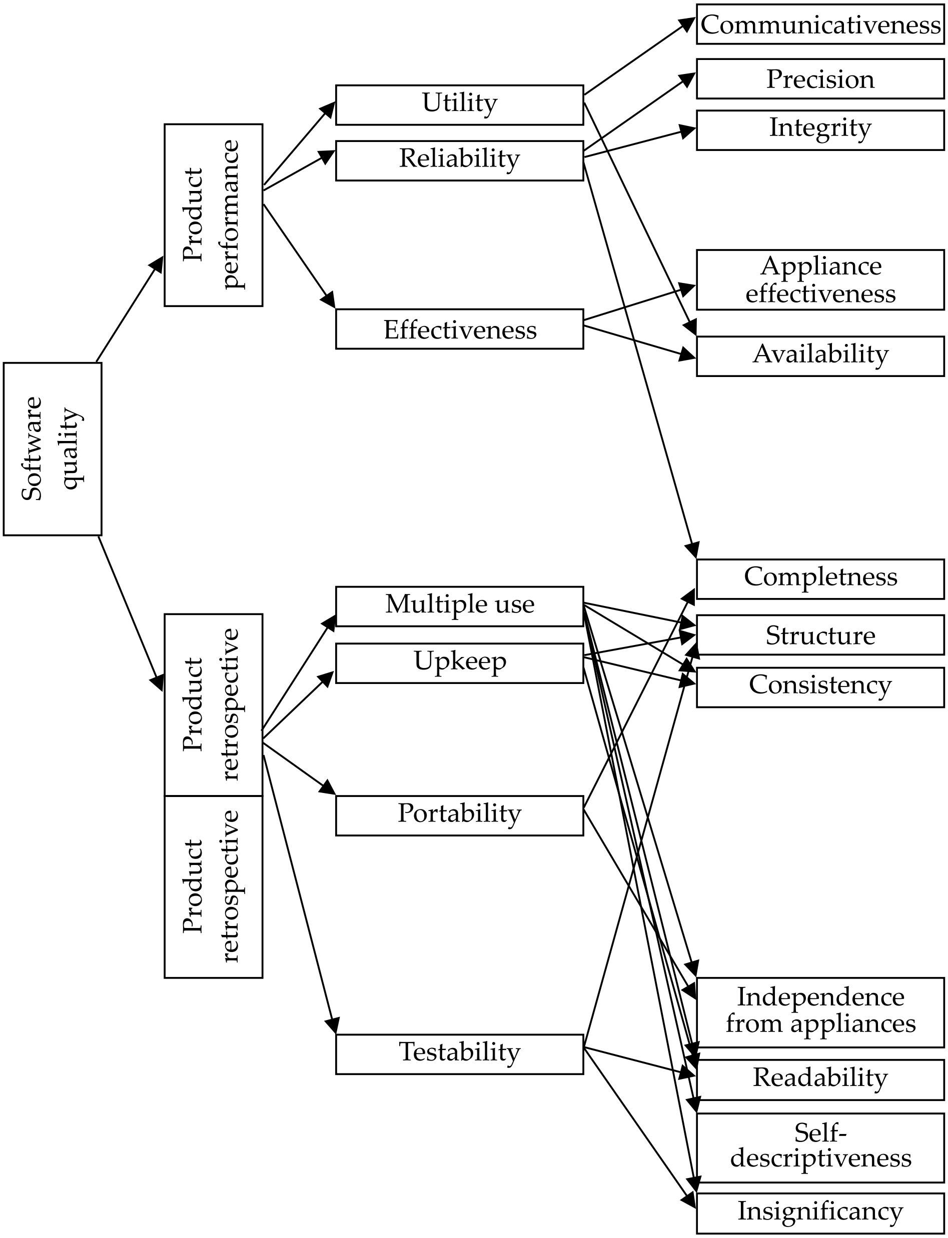

Figure 1. Model of software quality

Source: [Fenton, 1999, p. 86].

Another classification was suggested in [Ciesielczyk, Watras, 1995]. Quality features of information system were divided into three groups:
- system structure,
- system susceptibility for monitoring and control,
- capability to meet customer information needs.

The following features could be distinguished in the system structure:
- system modularity – possibility to allocate typical system functions stemmed from attributes,
- system resilience – free use of structure mechanisms of information system according to the user needs.
- system affability – simple, understandable, communicative form of system maintenance,
- system safety,
- system integration – methodological integration of system elements.
- system efficiency (effectiveness, rationality, profitability and productivity),
- automatization – substitution of a human by computer system,
- system documentation, which is not strictly a structure feature but an integral part of the system.

3. A product-service model of software quality

The above mentioned criteria are limited to the features directly related to the software. At the same time, one can notice succeeding changes in the quality definitions. Material product quality (unlike the software, which is nonmaterial and comes under nonmaterial fixed assets) is treated as a number of features which should primarily meet customer needs. In this case we are talking both about product needs and additional features (warranty terms).

With an assumption that software quality shouldn't consist only of direct product features, a product-service model of software quality was presented on figure 2. Two main feature categories were emphasized: product and operation features and distributor features. The product features are divided into two categories: direct and indirect. The following criteria were considered as direct features:
- functionality,
- reliability,
- utility,
- productivity,
- upkeep,

– portability,
– quality in use.

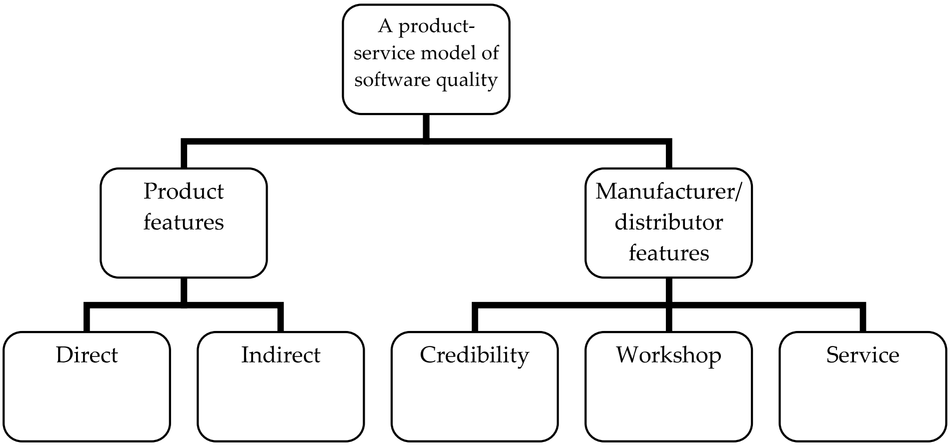

Figure 2. A product-service model of software quality
Source: Own elaboration.

Indirect features form a group of additional criteria which are important for the end user and influence the software quality indirectly. These criteria are the following:
– economical effectiveness which takes into account not only license charge, but training costs and upkeep,
– implementation effectiveness considering time, training extent and indispensible user competences
– additional product elements such as user and administrator documentation.

Software manufacturer/distributor activity has an important influence on customer satisfaction. Therefore, 3 criteria are considered to influence software quality:
– manufacturer/distributor credibility,
– manufacturer workshop,
– service.

Evaluation of manufacturer credibility is made to ensure a potential user about:
– legality of purchased software,
– possibilities of software upgrade,
– stable position of the manufacturer on the market.

Manufacturer evaluation includes:
– the date of company set up, which proves the stability of the enterprise (or the trademark) on manufacturer's market. Strong competition eliminate weak,

unprofessional companies. It happens that product advertising doesn't correspond with product quality,
- the date of system establishment; normally the manufacturers should improve their products on regular basis – new products should be more up-to-date,
- the evidence about system generation; although newer products should be more up-to-date, higher number guarantees better system functionality,
- credentials,
- warranty period,
- the number of implementations,
- the number and type of attained certificates,
- the number of qualified employees.

Evaluation of manufacturer workshop helps to check the resources which support the software tasks. Evaluation of manufacturer workshop includes:
- system environment – type of operation system, kind of network system, software programming language,
- database type,
- system equipment requirements,
- manufacturing style – engineering and production,
- tools used for system engineering support,
- control and test software,
- quality control process.

Service includes mainly two basic activities:
- necessary changes in the software on demand of the purchaser,
- program errors elimination,
- improvement of future programs.

Conclusion

The software is a compound product. A user or a potential customer is often not aware about consequences of certain solutions used in the software. Sometimes a user is not able to define his real needs. There are some hidden needs which appear only after the software implementation. It could happen that suggested solution doesn't meet several hidden needs and at the same time provides several solutions which are completely redundant for the enterprise. These solutions very often create extra cost of the ordered product.

Therefore, the models of software quality are of great importance. They allow to identify real company needs. The software implementation is a strategic decision influencing company development.

References

1. Beynon-Davies P. (1999), *Inżynieria systemów informacyjnych*, WNT, Warszawa.
2. Ciesielczyk T., Watras G. (1995), *Cechy jakościowe systemu informatycznego rachunkowości*, "Rachunkowość", nr 4.
3. Fenton N. (1999), *Zapewnienie jakości i metryki oprogramowania,* in. Górski J. (eds.), *Inżynieria oprogramowania w projekcie informatycznym*, ZNI MIKOM, Warszawa.
4. Kisielnicki J. (2001), *Wstęp do informatyki w zarządzaniu*, "Informatyka w zarządzaniu", nr 3.
5. PN-ISO/IEC 20000-2:2007, *Information technology – Service management-Part 2: Code of practice.*
6. PN-ISO\IEC 25000:2008*, Software engineering - Software product Quality Requirements and Evaluation (SQuaRE) – Guide to SQuaRE.*
7. PN-ISO/IEC 25051:2009, *Software engineering - Software product Quality Requirements and Evaluation (SQuaRE) – Requirements for quality of Commercial Off – The – Shelf (Cots) software product and instructions for testing.*
8. PN-ISO/IEC 27005:2010, *Information technology – Security techniques – Information security risk management.*
9. Pressman R.S. (1992), *Software engineering. A practitioner's approach*, McGraw-Hill, International Edition.

Chapter 7
The potential of social media in innovation processes of small and medium tourist enterprises

Sebastian Kopera

Introduction

Contemporary economy is often named a "knowledge-based", what refers to the importance of knowledge in value creation processes. What is more: effectiveness of knowledge creation and utilization in organizations, institutions, communities and individuals is a factor of key importance for social and economic development. The importance of knowledge is closely related to the possibility of personnel and organizational learning, resulting in innovations. And the capability for fast innovation creation and implementation, which is determined by relational architecture supporting acquiring knowledge from employees and external partners, is a key competitiveness factor [Kay, 1996, p. 154].

Innovation is more and more dependent on information technologies. The influence of ICT on innovation processes and their results is multi-faceted. First, ICT as a basic tool for communication supports, facilitates and accelerates information exchange within organization and between organization and its environment. And new information can materialize in a form of innovation. Second, ICT supports knowledge management and learning processes which also may result in innovative changes. Finally, ICT supports development of internal and external relationships, and this way provides access to new knowledge resources, product ideas, and other factors stimulating inventing, developing and introducing innovations by companies.

New developments in the area of IT – being itself "innovations" – push forward the level of innovations and pace of their introduction within and across different industries. One of such – relatively new – developments are social media (SM). Since 2004, when T. O'Reilly gave name to the new trend in Internet evolution – web 2.0 [O'Reilly, 2005] – the social media landscape has evolved dramatically. And it is ongoing process. Social media have been also a subject of rising number of researches, also in business and management related fields, and also in relation to innovation. However the role of SM in innovation process is rarely a central issue in researches.

The aim of this text is to analyze the potential of SM utilization in innovation processes executed in small and medium tourism enterprises and tourism regions. The role of innovation in company competitiveness shaping is incontestable in most sectors and industries, and so is in tourism industry. However the specificity of innovation processes may differ substantially across economy. The same refers to utilization of ICT and SM to their support and facilitation.

The following sections will develop on: innovation in tourism sector, overview of SM in the context of innovation processes in tourism. The text will be closed with the outline of possible research directions.

1. Innovations – theoretical background

Innovations can be defined as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" [OECD & Eurostat, 2005, p. 46].

In literature there are different typologies of innovation. One of the most popular comes from Oslo Manual, and if defines 4 types of innovations: product, process, marketing and organizational ones [OECD & Eurostat, 2005, pp. 46–51]. Innovation activity of a company depends on the characteristics of its links to varied sources of information, knowledge, technology, practices as well as human and financial resources [OECD & Eurostat, 2005, p. 20]. In general two basic sources of innovative change can be named: external and internal once [OECD & Eurostat, 1997, p. 26]. This distinction can be related to location of both: innovation-resulting activities and their executors (innovation system actors) as well as sources of information being used in innovation process.

Internal sources of information are departments and processes involved in innovation processes. Typically (however not in tourism sector) the basic internal actor in this field is R&D department, but innovation processes can be executed and related information and knowledge generated in/across virtually all organizational units. However for effective realization of innovation processes an initial reservoir of information and knowledge is a prerequisite. This circumstance seems to be one of the most important barriers for innovation in European tourism industry, which is dominated by micro enterprises[1] with limited knowledge and information resources. It is also the reason why SMTE should tap into external

[1] Over 90% out of 1,8 mln European tourism enterprises employ less than 10 people [*Study on the Competitiveness of the EU tourism industry*, 2009, p. 20].

knowledge resources and develop efficient cooperation with external actors [OECD & Eurostat, 2005, p. 39].

External innovations (or information and knowledge for innovation) can be acquired from open-access sources, be result of cooperation in R&D sphere with external actors, and the result of purchasing knowledge or technology [OECD & Eurostat, 2005, p. 20]. Innovation process nowadays requires involvement o different stakeholders, what is true particularly in case of SMTE. Knowledge constituting the basis for innovations appears not only in people and organizations, but also in relationships between organizations [Gummesson, 2012, p. 190]. That fact, together with substantial dispersion of knowledge and resources imposes necessity of joining together knowledge originating from different institutions to make innovation processes effective [Kowalski, 2010, p. 11]. Networking is oriented toward stimulation of knowledge exchange and learning processes in and between enterprises [Kowalski, 2010, p. 10].

2. Characteristics of innovation – related issues in tourism

Innovation – although of high importance for competitiveness – is not a central issue in tourism management and research. Thus the existing situation in tourism sector is often referred to as "innovation defectiveness" [Hjalager, 2002]. It is necessary to understand the sectoral context for innovation processes in tourism because it determines the scope and form of possible SM applications for their support.

Based on extensive literature review on tourism innovation practices and research, A.M. Hjalager has defined a number of characteristic features of innovation processes in tourism [Hjalager, 2002; Hjalager, 2010]. Generally SMTEs have insufficient knowledge and resources to execute innovation processes on their own, what redirects their attention toward environment, as a source of information, knowledge and – eventually – ready-to-use innovations. The most important role in SMTE knowledge and inspiration search play other actors from value adding chain: suppliers ("pushing" knowledge embedded in their products and services) and customers (revealing their needs and preferences and creating market "pull"). Direct tourism-related R&D knowledge transfer is unique what results from lack of pull for general knowledge (insufficient competencies in its utilization) on one hand and poor knowledge transfer mechanisms in tourism industry on the other. Important role in innovation system in tourism play local governments, clusters and DMOs, which can both: on their own generate and provide knowledge for tourism business (knowledge "push") and create networking environment enhancing cooperation and knowledge transfer between tourism industry actors in destinations. And last – but not least – the most "innovation-engaged" technology in tourism industry is and – probably – will be in the future ICT. In this context ICT appears as the innovation itself and as the infospace supporting innovation processes in which participates enterprise. Both form are important and can appear simultaneously e.g. setting up social media existence (innovation) opens channels for customer opinions, that can be source of further inspirations. However in the context of the presented chapter the second one is more important, and will be describe in more detailed way.

3. Social media in tourism innovation processes

Social media can be defined as: "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content" [Kaplan, Haenlein, 2010, p. 61]. This "group" expands daily, and covers wide span of different, often pervading each other tools, like: social networking sites, media sharing sites, blogging and microblogging sites, wikis, social review sites, social bookmarking sites, forums and usegroups, web auctions, aggregating channels, interactive applications, webinars, instant messaging systems [Kopera, 2009a, p. 422; Woodcock, Green, Starkey, 2011, p. 64; Baird, Parasnis, 2011a, p. 4].

Very important, and distinctive feature of SM (in relation to most other ICTs) are web communities, that can be defined as "a collective group of entities, individuals or organizations that come together either temporarily or permanently through an electronic medium to interact in a common problem or interest space" [Plant, 2004]. Social media enable and facilitate emerging and functioning of web communities through different tools for communication, collaboration, resource sharing, etc. From business innovation point of view virtual community can be viewed as:

- tacit and explicit knowledge repository,
- test bed for idea verification, and
- target for innovation dissemination and promotion.

With regard to enterprise borders virtual community can be located outside the company (involving customers, suppliers, partners), within the company (community of employees) or it may be cross-border group involving employees and external actors. Location of virtual community and supporting SM (together with SM type) will determine: the scope and differentiation of available knowledge and information, control over innovation processes and their results, ease of knowledge access and retrieval, outreach of innovations, etc.

Although the most popular applications of SM for business purposes are in marketing area with the aim to foster customer engagement, those instruments can be also utilized in "innovation oriented" activities, like search for opportunities for customer insights and cocreation [Baird, Parasnis, 2011b, p. 4] also in form of community based innovation contests [Bullinger et al., 2010], knowledge management [Kopera, 2009b], employee communication [Barker, 2008], learning [Leino, Tanhua-Piiroinen, Sommers-Piiroinen, 2012; Jussila, Kärkkäinen, Leino, 2012] or straightforward open innovation processes [West, Gallagher, 2006].

The analysis of usability of SM for innovation purposes should begin with short overview of the role of all kinds of ICT in business, most of the research publications in this area does not differentiate solutions, or – even if they do – they still treat them as one category with the common features (what can be misleading).

Although ICT utilization in innovation had been empirical fact for a long time, it appeared "officially" in fifth generation innovation model described by R. Rothwell in the early 90th of the XX century as a tool increasing speed and efficiency of product development activities within the innovation network [Hobday, 2005, p. 126]. The main role of IT was then automation and speeding up innovation processes. This attitude persisted over many years, to some extent successfully supporting reengineering, and other initiatives.

Actually ICT represents innovation supporting potential in 3 basic fields: information management [Lazoi et al., 2011, p. 399], knowledge management and learning [Gummesson, 2012, p. 189; Lazoi et al., 2011, pp. 398–399] and cooperation supporting and relationships building [Najda-Janoszka, 2010, s. 59; Kohtamäki et al., 2012, p. 1299, 1301].

However those issues are quite controversial. Many authors have pointed out barriers in ICT application to innovation-related processes [Warner, Witzel, 2005], which are related to:

- standardization and structuring requirement – often required for effective transformation and maintenance in different IT systems, makes it more suitable for standard, operational information exchange than for supporting new solutions and developments [Baraldi, Nadin, 2006, p. 1114],
- information stickiness – difficulties and costs related to information retrieval, transfer and application in new place [Hippel, 1994, p. 429],
- strong internal ICT competencies as prerequisite for ICT utilization to innovation process support [Hobday, 2005, p. 129].

All those objections seem deeply reasonable in technical context in which they were rooted (technically advanced solutions, often based on ERP logic, with high integration between subsystems)[2]. However they (mostly) do not apply to so-

[2] Not mentioning organizational context which consisted of mostly medium and big manufacturing companies.

cial media which: are (generally) not expensive, do not require deep technical knowledge to be used effectively, operate on low-structured information and are easily accessible. As they are based on the internet and internet based platforms, they give also open access for all potential actors without system pre-integration as requirement. Information flow is rather informal, what stimulates more open and intimate relationships between partners, enabling transfer of different types of knowledge.

Of course their main function of SM is not automation and speeding up information flow in innovation process (as it was in case of "traditional" ICTs), but still their innovation supporting potential can be analyzed in the previously mentioned dimensions: information management, knowledge management and learning and relationship management (figure 1).

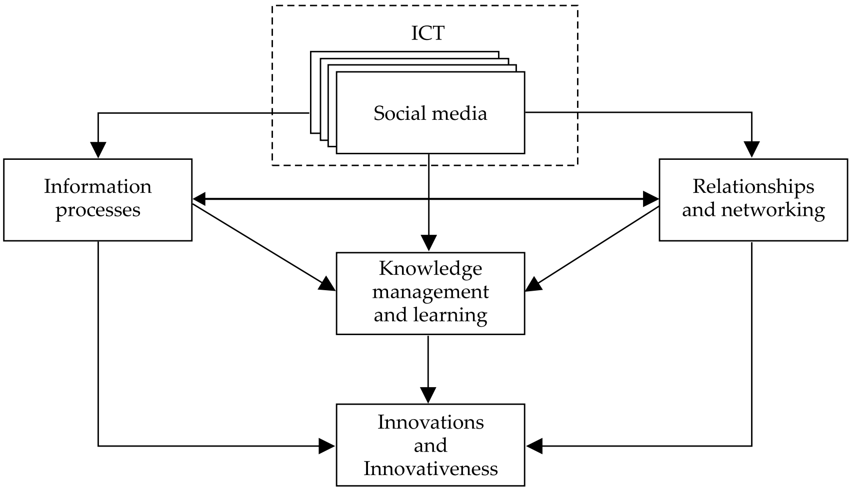

Figure 1. Model of the influence of SM on innovation processes
Source: Own elaboration.

As an example of ICT social media are primarily information processes supporters. Information on SM is rather: informal, general and context embedded (extraction and interpretation is required if it is to be utilized in innovation processes), and – mostly – user generated (what makes it difficult to control by other participants of information process). SM-supported information flow influences relationship management, knowledge transfer and learning, and directly innovation process on every stage.

Knowledge management and learning are crucial for innovation. Utilization of different social media in those processes has been drawing rising attention of researchers. SM give wide access to the knowledge of external partners, what is crucial for tourism enterprises facing internal knowledge shortage. Searching for insights and new knowledge can be based external travelers' forums, expert blogs, or blogs/community portals of other actors – educational institutions, governmental/selfgovernmental bodies, technology suppliers or even competitors (benchmarking). SM are communicative and collaborative media. They require competencies in their utilization both from the enterprise – that searches for and extracts information and knowledge – but also external partners – information and knowledge providers. If SM are to become mainstream (or at least important) medium in tourism education and dissemination of tourism research results institutions have to work out new, and effective methods of their application for innovation fostering.

Relationship building is probably the most widely recognized aspect of SM utilization, mostly due to relationship marketing. Of course the focal point of marketing literature is to increase effectiveness of marketing functions through the use of new and diversified communication and distribution channels. SM is seen here as the element of marketing and process innovation. A very significant discussion is run currently on Social CRM – customer relationship management supported by social media [Greenberg, 2010; Baird, Parasnis, 2011a]. However close and trust-based relationships with external actors open channels for innovation, knowledge and information flow, as well as enhances cooperation between partners, what may result in innovations created and introduced.

Conclusion

Social media are well known examples of consumer technology, with great tourism innovation potential, that is utilized in limited extent. For various reasons social media are very promising as far as "repairing innovation defectiveness in tourism" is concerned: they give access to vast volume of knowledge accumulated in online communities, are easily accessible and well known by rising group of employees, do not require extended technical knowledge, or IT investments. What is more: they are versatile and can be applied and utilized by tourist enterprises internally as well as in innovation-related interactions with their environment: tourists, suppliers, public and local administration, clusters or educational and R&D sector. For the last groups SM create new channels for knowledge dissemination.

However SM differ from traditional ICTs substantially. It means that the rules of their effective utilization for tourism innovation-fostering purposes are still to be developed, verified and described. There is a number of research questions to be answered. Some of the important (from tourism innovativeness point of view) albeit general questions are listed below:

1. How SMTE utilize SM to manage information, exchange knowledge, learn and build relations with different groups of stakeholders (internally and externally) considering specific features of different SM tools and relationship types?
2. What are the main determinants/barriers for effective SM application for innovation support?
3. How can SM be applied to foster knowledge transfer from R&D and educational institutions to enterprises?

Answers to those questions should create framework for understanding of the role of SM in innovation processes (not only in tourism sector), and enable formulating practical recommendations for SMTE and cocreators of regional cooperation and transfer (info)space.

References

1. Baird C.H., Parasnis G. (2011a), *From social media to Social CRM. What customers want. Part 1*, ftp://public.dhe.ibm.com/common/ssi/ecm/en/gbe03391usen/GBE03391USEN.PDF, accessed 14.04.2013.
2. Baird C.H., Parasnis G. (2011b), *From social media to Social CRM. Reinventing the customer relationship. Part 2*, http://www.ibm.com/midmarket/uk/en/att/pdf/social_media_Part_Executive_Report.pdf, accessed 14.04.2013.
3. Baraldi E., Nadin G. (2006), *The challenges in digitalising business relationships. The construction of an IT infrastructure for a textile-related business network*, "Technovation", Vol. 26(10).
4. Barker P. (2008), *How Social Media Is Transforming Employee Communications at Sun Microsystems*, "Global Business and Organizational Excellence", (May/June).
5. Bullinger A.C., Neyer A., Rass M., Moeslein K.M. (2010), C*ommunity-Based Innovation Contests: Where Competition Meets Cooperation*, "Creativity and Innovation Management", Vol. 19(3).
6. Greenberg P. (2010), *CRM at the Speed of Light, Fourth Edition: Social CRM Strategies, Tools, and Techniques for Engaging Your Customers*, McGraw-Hill.
7. Gummesson E. (2012), *Total Relationship Marketing*, Taylor & Francis.
8. Hippel E. Von (1994), *Sticky Information and the Locus of Problem Solving: Implications for Innovation*, "Management Science", (April).
9. Hjalager A.M. (2002), *Repairing innovation defectiveness in tourism*, "Tourism Management", Vol. 23.
10. Hjalager A.-M. (2010), *A review of innovation research in tourism*, "Tourism Management", Vol. 31(1).

11. Hobday M. (2005), *Firm-level Innovation Models: Perspectives on Research in Developed and Developing Countries*, "Technology Analysis & Strategic Management", Vol. 17(2).
12. Jussila J.J., Kärkkäinen H., Leino M. (2012), *Learning from and with Customers with Social Media: A Model for Social Customer Learning*, "International Journal of Management, Knowledge and Learning", Vol. 1(1).
13. Kaplan A. M., Haenlein M. (2010), *Users of the world , unite! The challenges and opportunities of Social Media*, "Business Horizons", Vol. 53.
14. Kay J. (1996), *Podstawy sukcesu firmy*, PWE, Warszawa.
15. Kohtamäki M., Vesalainen J., Henneberg S., Naudé P., Ventresca M.J. (2012), *Enabling relationship structures and relationship performance improvement: The moderating role of relational capital*, "Industrial Marketing Management", Vol. 41(8).
16. Kopera S. (2009a), *Social software in information environment of tourist enterprise*, in Kubiak B.F., Korowicki A. (eds.), *Information Management*, Gdańsk University Press, Gdańsk.
17. Kopera S. (2009b), *Application of social software for knowledge management*, in Lewandowski J., Jałmużna I., Sekieta M. (eds.), *Challenges in enterprise management of today*, A Series of Monographs, Technical University of Lodz, Łódź.
18. Kowalski A.M. (2010), *Kooperacja w ramach klastrów jako czynnik zwiększania innowacyjności i konkurencyjności regionów*, "Gospodarka Narodowa", nr 5–6.
19. Lazoi M., Ceci F., Corallo A., Secundo G. (2011), *Collaboration in an aerospace smes cluster: innovation and ict dynamics*, "International Journal of Innovation and Technology Management", Vol. 8(03).
20. Leino J., Tanhua-Piiroinen E., Sommers-Piiroinen J. (2012), *Adding Social Media to e-Learning in the Workplace: Instilling Interactive Learning Culture*, "International Journal of Advanced Corporate Learning" (iJAC), Vol. 5(3).
21. Najda-Janoszka M. (2010), *Organizacja wirtualna*, Difin, Warszawa.
22. O'Reilly T. (2005), *What Is Web 2.0. Design Patterns and Business Models for the Next Generation of Software*, www.oreilly.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html, accessed 14.03.2014.
23. OECD, & Eurostat (1997), *OECD Proposed Guidelines for Collecting and Interpreting Technological Innovation Data – Oslo Manual* (OECD, Ed.), Paris.
24. OECD, & Eurostat (2005), *Oslo Manual*, OECD Publishing, Paris.
25. Plant R. (2004), *Online communities*, "Technology In Society", Vol. 26.
26. EC: Directorate General Enterprise and Industry – Tourism Unit (2009), *Study on the Competitiveness of the EU tourism industry*, http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5257, accessed 14.04.2013.
27. Warner M., Witzel M. (2005), *Zarządzanie organizacją wirtualną*, Oficyna Ekonomiczna, Kraków.

28. West J., Gallagher S. (2006), *Challenges of open innovation: the paradox of firm investment in open-source software*, "R&D Management", Vol. 36(3).
29. Woodcock N., Green A., Starkey M. (2011), *Social CRM as a business strategy*, "Journal of Database Marketing & Customer Strategy Management", Vol. 18(1).

Chapter 8

Alignment IT-business by defining needs as the key to success IT projects

Monika Woźniak

Introduction

The evolution of IT ends the stage of supporting the organizational structure and functioning of businesses only. Technological progress, internetization, digitalization, changing of market conditions, legal requirements, etc. made IT deep rooted into organizations and their mechanisms of action. Increasingly it begins to be one of bloodstream with business processes.

Today, success can therefore guarantee proper interaction of IT-business. In the era of popularization projects, including IT projects should be to focus on the appropriate coordination IT projects undertaken with the elaboration of business strategies.

The study made it possible to specify a key area in projects for the above issues. It is the phase of defining needs. In the light of the forecasts of the IT evolution one should look at this stage in other way, than just through the prism of guidance from the standards and methodologies for IT project management. Refining and creating new, more flexible methodologies, activity-based standards and certification, and the use of modern technologies and tools, did not bring in fact the expected results. Appears need for a broader and deeper look at this stage in the project. The study was directed at finding bugs and the elements for inclusion in the proper implementation of this phase. This was done in the context of evolutionary trends[1]. There was a need to pay attention not so much on the same methodology for IT, but at their use, and aspects of human factors (often marginalized in the process of IT).

Research related to the phase of defining the needs of IT projects are part of the research of the critical success factors of IT projects conducted by the author. Research path based on the exploration and analysis of the literature, the results of current research reports, the information from industry symposiums, project documentation and conclusions obtained from empirical studies.

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[1] Determined based on data from: PMR Report, IT market in Poland 2011. Development forecasts for 2011–2015; Forrester Research Report 2012; Conference Smart PM, Kraków, march 2013.

The subject of empirical studies were cases for IT projects conducted in the SME sector in Poland in 2011–2012. The research method used interview for the IT teams [Silverman, 2006] and observation in the area – the client and its place in IT projects [Hennink et al., 2010]. Projects were carried out by various methodologies (with classic and agile group or other individual). Important for the research was to capture the project in its initial stage – the stage of defining needs. After initial research the correctness could be indicate – superiority of unilateral approach to the problem of defining the needs of IT projects, regardless of the methodology used.

This chapter presents the lessons learned from these areas of research (literature, reports, symposia, project's documentation, empirical research).

1. Alignment IT-business

Alignment IT-business by Professor Jerry N. Luftman[2] is "the use of IT in an appropriate way and in due time, in harmony with the strategy, objectives and business needs" [Luftman, 2003]. This brief definition is in all aspects of the problems associated with the integration of IT strategy with business strategy. These include alignment among other things: technology, work organization, processes, human factors, communication processes.

It is important to understand alignment as an ongoing process, rather than any particular stage of development of the organization. In the alignment is entered following the changes in the environment, enterprise and technology. It can and should also result from the prospective thinking about changes.

Alignment IT-business should be seen in the context of integration between two planes: matching IT to business and business to IT fit. Matching IT to the business is focused on supporting business strategies through broadly understood information technology. Fitting business to IT whereas allows you to modify business strategies based on properly selected information technology. Each of these planes carried out separately does not create the added value of being able to bring their mutual interaction [Kubiak, Korowicki, 2009]. Moreover, building alignment on the basis of the two planes interaction enhances the organization with new competencies distinguishing it from a business point of view [ISACA, 2012]. In addition, the role of IT in the process of alignment will be working out transformational applications and infrastructure associated with them which will change models competing companies.

[2] Professor J.N. Luftman is a world authority on alignment IT-business, author of The Strategic Alignment Maturity Model (SAMM).

Forrester Research report points out, that only 12% of organizations in Poland in their business strategy is based on alignment IT-business [Forrester Research, 2012]. Other entities lack of communication at the crossroads of IT-business. According to the Strategic Alignment Maturity Model (SAMM) four key factors negatively affect or make impossible adaptation of IT-business. These include the lack of [Brier et al., 1999]:

– close relationship between business and IT,
– prioritizing IT initiatives, and failure to comply with obligations,
– understanding for business from IT,
– leadership abilities among IT managers.

At the core of the above factors is the lack of partnership, communication and skills for effective exchange of views, identifying and understanding the needs. On the IT side there is a lack of awareness of business objectives, and on the part of business – lack of understanding for IT and its specifics [Holtsnider, Jaffe, 2010]. It is therefore important promoting cultural understanding, sharing of knowledge and experience of IT and business representatives. Only through the ability to proper defining the needs, IT can become a partner in the creation of business value, and the company gain new competitive quality.

The starting point for entities should therefore be to determine the actual degree of matching IT-business for their organization and functioning in the context of broadly understood environment [Chan, Reich, 2007]. Then, specify the target possible to achieve in a specific time horizon, level alignment. It should be the result of interaction business objectives and IT of the organization. Determination of target level help planning appropriate projects run and defining the needs translated to the objectives, scope, project plan.

In the context of alignment IT-business, it is important source of initialization needs. It may be three areas:

– IT,
– business strategy,
– interaction of IT-business.

The first two gives a flattened image needs. The same IT can generate needs embedded in the latest trends of technology, but inadequate in to the real needs of the organization. Frequently the result of this source of initiating needs are IT products or services whose functionality is used at 20% [Gartner, 2012]. Directing to existing the business strategy whereas results so passive approach to defining needs. It does not include the potential of innovative new technologies and capabilities of transformation the structures and activities aimed at improving the maximum to improve the functioning of the organization.

Only needs stemming from the interaction of IT-business form the basis of proper defining needs. In this perspective, the defining needs should be seen as a process rather than a closed stage. Its result will be a complex, multifaceted, forward-looking and open specification needs.

2. Defining needs – initial phase

Defining needs is closely related to the determination of the subject, purposes, scope and IT project plan and at a later stage of derivative elements [Frame, 2001]. This issue should be given enough time and enough space in the project, to be able to accurately and correctly identify and describe all the needs in the area.

The most common mistakes are:

- acceptance needs such as client expresses it,
- acceptance needs such as project team sees them,
- incomplete definition of needs,
- internal lack of clarity in defining – superficial and poorly defined needs,
- too short a time planned for this stage,
- lack of awareness, commitment and/or experience on one or both sides (the project team/client).

The above-mentioned approaches only lead to superficial and incomplete specification of needs, often simply wrong [Jackson, 1995].

Defining needs should therefore be seen as a complex, multi-step, staggered process. It requires both expertise, but also openness, mindfulness, commitment and experience. The best results also bring the ability to select and support this process, adequate methods and techniques of psychological and social. Recommendations are determined on the basis of experience gained from defining needs. As a result of studies were identified additional important issues in this area:

- necessity to engage all stakeholders in the process of defining the needs (initiators, implementers, recipients, developers support mechanisms),
- making sure at every step of the process that all parties understand in the same way given the need (so clarification of communication),
- creation multi-threaded and multi-faceted descriptions for the needs perceived differently by each party,
- at this stage avoidance flattener needs, making their hierarchy or premature to propose solutions.

This approach to defining needs will allow for precise and detailed to determine the purpose of the IT project. This in turn will result in the correct specification of the functional and technical requirements. The term "correct specification" is understood as a specification takes into account the real needs (resulting from defining stage) and adequate and optimal solutions for them [Gottesdiener, 2002].

Important in defining needs is also the fact of their volatility [Frame, 2002]. It can result from various factors such as market conditions, legal changes, budget, changes in technology and human factors considerations. Therefore, important are: close cooperation between IT and business, continuous monitoring of changes and on the basis of creation a broader perspective of future environment [Wyatt-Haines, 2007]. These actions will enable to minimize deviations between the defined and actual needs.

Defining needs is one of the most important stages of the project. It provides the basis for determining the subject, purposes and scope of the project. These elements, in turn, translate into a project plan. Plan in its assumption determines the most effective ways of delivering specified needs [Shim et al., 2010]. Therefore, any error or irregularity in the area of defining needs a significantly burden the project plan. Any change in the area of needs translates into the necessity changes to the project plan. This may entail exceeded the accepted dates, budget, scope, quality requirements, etc. These dependencies are the cause of failures of projects.

The correct approach to the identification of needs, therefore, is to take into account the above-mentioned aspects. This will allow the proper definition of the subject, purposes and scope of the project and the construction plan, which is the derivative. In this way targeted actions should reflect the interaction of IT-business, increase the success rate of projects in order to create new value for the organization [Ireland, 2011].

3. Well-defined needs and alignment IT-business

The consequence of well-defined needs should achieve the desired alignment IT-business. This statement assumes, of course, flawless implementation of stages following the definition of needs phase. Implementation in accordance with the procedures adopts methodology. They can come here yet questions the appropriateness of the methodology to such items as: the specificity of the project implemented, the team executing the project, the type of customer [Woźniak, 2012]. This chapter shows how a well-implemented needs definition phase resulting in further steps aimed in the direction of the interaction, and better alignment IT-business [Kralewski, 2012].

It should be noted that in this area may exist specific coupling between three elements: IT, business strategy and interaction IT-business strategy and the quality of the generated needs and their results (table 1).

Table 1. Elements initiating needs vs. the quality of the generated needs and their results

Element initiating the need	The generated needs	The effect of meeting the needs
IT (sector, company, department)	– the latest technological and functional solutions, – standard IT solutions, – unsuited to real business needs, – not having a business justification	– overpriced IT infrastructure, – untapped functionality and technical resources, – lack of full and consistent support of business needs, – certificates, standards and training which have no impact on the organizational structure and business activities
Business strategy	– unsuited to current technological solutions, – under-performing IT capabilities	– passive mapping the organizational and functional structure, – lack of improvements through modern technological solutions, – not comply with the applicable standards
The interaction of IT-business strategy	– compromise, – complete, – following the new technology and simultaneously consistent with the real needs business, – optimizing organizational and functional structure of the company and its IT infrastructure	– support business activities through appropriate technological solutions, – comply with the applicable standards, – modification of organization and functioning of the company by coupling IT-business strategy, – competitiveness and innovation, – flexible response to changes in environment

Source: Own elaboration.

Most mature and best solutions in terms of alignment IT-business has been initiated by the needs generated on the basis of interactions of IT-business strategy. Other elements – the same area of IT or business strategy, without mutual cooperation, will always generate a picture of the needs affected by errors. Implementation as defined needs will bring IT products and IT services functionalities inadequate to the actual business requirements.

The next step after a detailed clarification of needs of all stakeholders should be:

– identify the needs from the perspective of the individual structures,
– comprehensive look at the defining of needs – from the perspective of all levels of the organization,
– imposition obtained images of needs in order to establish a complex, multi-faceted, but a consistent definition of the needs of the organization.

Here you can also follow the decisions that need to be rejected, and that implemented in the IT project. Elements that help in the selection of needs will be:

- business objectives, which are to serve,
- resources which the company has (technical, human specialists, knowledge and skills, financial),
- costs of their implementation in the framework of the IT project.

Should be eliminate any conflict between the needs, determine interdependencies (if there are), the hierarchy of importance and to relate them to business purposes which they are intended.

A very important issue that has emerged in the process of ongoing research is the issue of support for the project by the human factor [Langer, Yorks, 2013]. Problems of supporting IT projects are already achieved during the definition phase, and then effecting the whole process and the success of IT projects. What in the future the various departments and their employees will provide to support [Bhatia, 2013] depend on their involvement in the definition phase needs, due to consideration for their points of view and understanding of the needs and awareness of the co-developed a comprehensive picture of needs. Each organization will be task-oriented units and quickly providing support for new ventures, as well as those who are distanced and slowly accept the changes [Burke, 2008]. Deepened research in this area led to the identification of important factors contributing to insufficient involvement or lack of them. These are: a sense of temporariness of work in the project and lack of success of the project translating to the personal benefits. It is important to capture it early in the project (which is to define the needs) and use of such techniques and methods that allow for the inclusion in the process of less engaged employees. Not marginalizing their role and their point of view turned out to be crucial for the completeness of the image of needs and success of the project.

Figure 1 is a pictorial show of the essence of properly performing definition phase of needs and its impact on the further stages of the IT project.

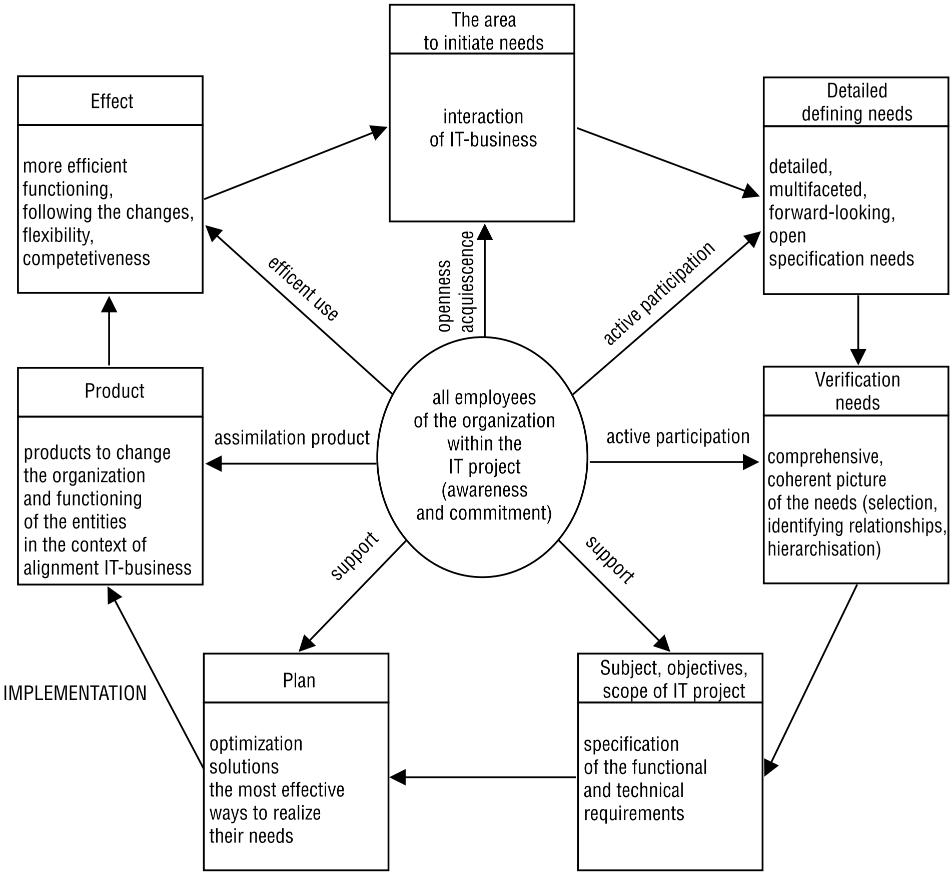

Figure 1. Defining needs in IT project

Source: Own elaboration.

Interrelation of elements and arrangement in the form of a circle indicates the cyclical nature of once begun the process of defining needs – based interaction of IT-business. Thanks to the openness of the organization to this process, IT-business alignment can become an integral part of the company's business strategy.

Conclusion

The issues of defining needs is one of the stages of every IT project. In the context of alignment IT-business and their interaction it should be that area that needs special attention. Awareness of its impact on the further implementation and success of IT projects implies a need for research in this direction and solutions for the proper understanding and conduct of this phase of the project. Works carried by the author of research have shown that the answers is not to be found in the same methodologies and technical tools. The chapter suggests, therefore, the necessity to pay attention to ways of their use and aspects related to human factors (often marginalized in the process of IT), as an opportunity to join the alignment IT-business. It is another author's study, created on the basis of research on the critical success factors for IT projects.

The success of IT projects is not possible without redefine the needs specification phase in the context of the significance of alignment IT-business and the necessity of mutual interaction. Of course, the final result of the IT project (its impact on the functioning of the organization) will depend largely on the understanding of the changes, the rate of acceptance and ability to effectively use them. This becomes more important phase defining the needs and care of commitment to the process of all employees in the organization. Developing a culture in the company, which is based on effective communication, collaboration and teamwork, will be supporting feature.

Sector, company or IT department must also transform in the process of transition from the function of the support to the role of a business partner. This transformation should occur both in the mentality of IT staff (training, selection of appropriate IT leaders) and the entire organization. Only building of IT infrastructure-based projects involving alignment IT-business, will enable the effective functioning, keep up with the market and be competitive. This approach assumes a continuous evolution in the field of IT and business strategies through their mutual interaction.

References

1. Bhatia R. (2013), *IT Governance Implementation–Formulating and Presenting Practical Business Cases*, "ISACA Journal", Vol. 1.
2. Brier T., Luftman J.N., Papp R. (1999), *Enablers and Inhibitors of Business-IT Alignment*, "Communications of the Association for Information Systems", Vol. 1.
3. Burke W.W. (2008), *Organization Change: Theory and Practice*, Sage Publications, USA.
4. Chan Y.E., Reich B.H. (2007), *IT Alignment: An annotated bibliography*, "Journal of Information Technology", Vol. 22.
5. Conference Smart PM (2013), Kraków.
6. Frame J.D. (2001), *Zarządzanie projektami w organizacjach*, WIG-PRESS, Warszawa.

7. Frame J.D. (2002), *The New Project Management: Tools for an Age of Rapid Change, Complexity, and Other Business Realities* (Jossey Bass Business and Management Series), John Wiley & Sons, San Francisco.
8. Gottesdiener E. (2002), *Requirements by Collaboration: Workshops for Defining Needs*, Pearson Education, Boston.
9. Hennink M., Hutter I., Bailey A. (2010), *Qualitative Research Methods*, Sage Publications Ltd, London.
10. Holtsnider B., Jaffe B. (2010), *IT Manager's Handbook The Business Edition*, Morgan Kaufmann, USA.
11. Ireland T.S. (2011), *How To Write A Great Information Technology Strategic Plan - And Thrill Your CEO*, USA.
12. *IT Alignment: Who Is in Charge?*, ISACA, http://www.isaca.org/Knowledge--Center/Research/Documents/IT-Alignment-Who-Is-in-Charge.pdf, accessed 15.12.2012.
13. Jackson M. (1995), *Software Requirements and Specifications: A Lexicon of Practice, Principles and Prejudices*, ACM Press, London.
14. Kubiak B., Korowicki A. (2009), *Information Management*, University of Gdańsk, Gdańsk.
15. Kralewski D. (2012), *Implementacja ładu informatycznego w małych firmach. Zarządzanie dziś i jutro*, "Prace Naukowe Wyższej Szkoły Bankowej w Gdańsku", Vol. 16.
16. Langer A.M., Yorks L. (2013), *Strategic IT: Best Practices for Managers and Executives*, John Wiley & Sons, Canada.
17. Luftman J.N. (2003), *Competing in the Information Age. Aling in the Sand*, Oxford University Press, New York.
18. Raport 2012 (2012), Forrester Research.
19. Raport 2012 (2012), Gartner.
20. Rynek IT w Polsce 2011. Prognozy rozwoju na lata 2011–2015 (2011), Raport PMR.
21. Shim J.T., Shin Sheu T., Chen H., Jiang J.J., Klein G. (2010), *Coproduction in successful software development projects*, "Information and Software Technology", Vol. 52.
22. Silverman D. (2006), *Interpreting Qualitative Data: Methods for Analyzing Talk, Text and Interaction*, Sage Publications Ltd, London.
23. Woźniak M. (2012), *Lider IT a dylematy i wyzwania współczesnych przedsięwzięć IT*, "Zarządzanie i Finanse Journal of Management and Finance", Vol. 10, No. 4 (part 3).
24. Wyatt-Haines R. (2007), *Align IT: Business Impact Through IT*, John Wiley & Sons, England.

Chapter 9
Relational Capital as the Organizational Structure Transformation Driver

Kazimierz Perechuda, Iwona Chomiak-Orsa, Wojciech B. Cieśliński

Introduction

Relational capital is a relatively new management tool, exemplifying a trend to achieve economic success through playing the organization's intangible assets.

The organizational lifecycle reduction implies the search for new stimuli and solutions determining an instant market success. Many owners of organizations hold development of relational networks to be one of the significant guarantees of market success. Such an approach to market prospects determines management models to address the special role of intangible assets and in particular – that of relational capital. What is more, contemporary organizations, with their blurred boundaries and networking-based operations, aiming for flexibility of relationships, consider relational capital to be a very special asset – not only a market activity driver, but also as a determinant influencing the shape of organizational relationships.

In the area of organizational management, the problem of relational capital management is regarded as a marginal issue, its role in development of the organization in terms of the impact on the organizational structure being entirely disregarded.

Therefore the authors, through scientific exploration in the field of literature survey, discussions on scientific seminars, as well as the research work in organizations, have recognized the need to bring up the problem of identifying the role of relational capital in development and transformation of organizational structures and the directions of its influence.

1. Stages of developing relations in an organization

The structure of any organization depends on the network of relations between stakeholders within it (consubstantial stakeholders [Chomiak-Orsa, 2013]), as well as between its contractual stakeholders.

The process of relations development is permanent. Any organization following market rules and pursuing maximum economic effects, as well as a non-profit organization, enters into relations, thereby determining the process of relational capital building. In literature and in practice as well, most attention is paid to the problems of developing relational capital in the area of the so-called client capital [Mikuła, 2006, p. 161] or relational rent earning [Cygler, 2009, p. 77]. These categories are related to analysis of the perspective of relations between the organization and its environment – in a narrower or broader meaning, while remarkably little attention is given to the importance of relations inside the organization. Yet, only conscious management and development of relations inside the organization can bring any effects in the long-term relational capital development.

When analysing the process of establishing and developing relations with stakeholders, a sequence of stages can be defined for each elementary relation. These stages should comprise specific tasks that contribute to achievement of organization's specific results. Table 1 presents the stages, the tasks and the results expected from the process of developing relations.

Table 1. Stages of developing relations between the organization and its stakeholders

Tasks	Methods	Results
STAGE I: Establishing relations		
– analyse options to establish relations, – assess relations form the strategic management perspective, – establish aware groups of personnel responsible for effecting and creating business relations	– strategic plenary sessions with the strategic and tactic level management, – employee participation in establishing relations, – sessions and seminars with employees, to build awareness and motivate to action	– relations structured and prioritized in terms of their importance for the organization, – influence of specific stakeholder groups identified, – organizational strategy reviewed in terms of the relational context, – employees awareness and engagement built
STAGE II: Arrangements – formalizing		
– evaluate organization's preparedness to implement the relational capital strategy, – identify gaps and inconsistency of actions, – evaluate the organizational system, – implement the necessary system solutions	– analysis of organization's approved strategies, – review of system solutions that can be anticipated, – employee surveys,	– the organization's management system evaluated, – algorithms of new relations developed along with the methods of implementing these into the day-to-day activity,

Tasks	Methods	Results
STAGE III: Development strategy		
– review and evaluate the existing relations, – benchmark the existing solutions, – plan changes and implementation of new relations	– business process mapping tools – meetings with stakeholders, – relations evaluation questionnaires, – dialogue with stakeholders, – sessions with stakeholders	– relations analysed and evaluated, – best practices implemented, – priorities for stakeholder-related actions set, – stakeholder groups defined, – strategies and action plans approved,
STAGE IV: Building trust		
– develop standards for stakeholder contacts, – set goals for relations, – make employees aware of their roles and responsibility for relational capital development, – identify problem areas and issues in the relations being designed, – establish assets access rules for stakeholders	– direct meetings with stakeholders, – using technology in order to improve accessibility and facilitate stakeholder communication, – workshops, – experimental meetings with stakeholders, – establishing a dialogue, – identifying possible solutions to problem situations and issues	– improved accessibility of information to organization's stakeholders, – trust in business contacts built, – stakeholder relations established and strengthened, – stakeholder contacts integrated, – innovative solutions for stakeholders to participate in relations development, – organization's reputation enhanced
STAGE V: Evaluation		
– define the method for and the scope of evaluating stakeholder relation satisfaction, – define the relations audit scope, – indentify failures, – develop a method for correcting failures,	– stakeholder audit, – internal dialogue system, – relation evaluation forms	– procedures for establishing and maintaining relations formalized, – regular communication channels for maintenance of relations established, – a system for creating organization and stakeholder value defined
STAGE VI: Cyclical improvement		
– duplicate the procedures, – identify and eliminate failures, – improve relations on a continual basis	– cyclical meetings and workshops with stakeholders, – periodical assessments of relations quality conducted by stakeholders,	– cyclical modification of relations improves quality of relations and rises employee awareness of the relational capital development importance to the organization

Source: Own elaboration based on: [Svendsen, 1998, p. 66; Klimas, 2011].

The organization's relational capital drivers can be categorized into three groups, depending on the degree of correlation between the organization and the stakeholder group determining the relation. With this approach to categorization of determinants, the following distinction can be adopted:

– directly dependent determinants,

– indirectly dependent determinants,
– independent determinants.

Figure 1 illustrates relations between various determinants originating in various stakeholder groups and the organization's relational capital.

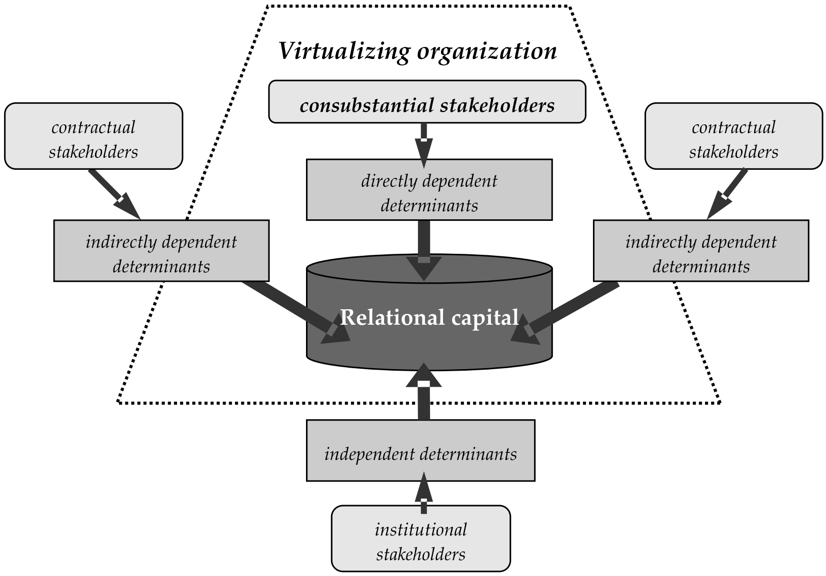

Figure 1. Stakeholder groups determining relational capital in a virtualizing organization
Source: Own elaboration.

Stakeholders actions are contributing to development of bi-polar forces influencing the situation. The internal (consubstantial) stakeholders are determining the quality of relations inside the organization first of all. The process of relational capital management with an in-house focus leads to development of relationships inside the organization representing some pre-defined values. In the context of global economy and market exchange which occurs increasingly in the cyberspace, any management of relational capital in a client-oriented manner is possible only through developing strong and long-term trust-based relations between the organization's consubstantial stakeholders.

On the other hand, the opportunities offered by technological developments contribute to disintegration of relationships inside organizations. Such phenomena as virtual project teams and telecommuting weaken the ties between various actors within an organization. Hence, contemporary organizations should perceive relational capital as a bi-polar driver for creating or strengthening their structures on the one hand, and on the other – as a catalyst for inappropriate or week organizational arrangements.

2. Relations as a driver affecting organizational structures

There are always some types of relations (integrating forces) hidden within every structure – otherwise no structure could come into existence. This rule applies also to classical organizational theories, where a company was regarded as a monolith generating revenue and profit from a skilful selection and allocation of means of production (figure 2).

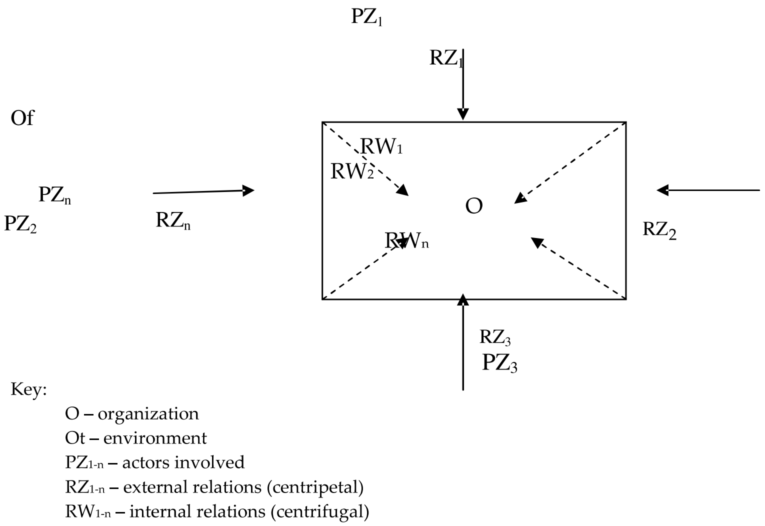

Figure 2. External and internal relations as centripetal forces

Source: Own elaboration.

Certainly, relations are intrinsically bidirectional. But under the conditions of low turbulence in the company external and internal environment, the amplitude of their oscillation is low (barely perceivable, just as the butterfly touch), thus causing an illusion of permanence and regularity of production processes, continuity, supply and sale.

At the same time, their centripetal influence is prevailing here, which means that the purpose of relations with stakeholders in the environment and internal actors (managers and personnel) is to build internal consistency through unidirectional aspiration of tangible assets, people and capital from the environment.

In modern management theories, conceptions and models, especially in a networking and virtual organization, the situation looks entirely differently.

Here, we are dealing with the following types of reorientation (figure 3):

- from the inside towards the environment,
- from tangible to intangible assets,
- from selling products and services to transferring information and knowledge,

– from classic structures (linear, top-down, linear mixed with top-down, divisional) to dispersed structures (network, virtual, fractal, agile, flat, hybrid, etc.),
– from vertical to horizontal structures,
– from structure to network.

Modern network corporations are hardly identifiable entities, which means that their capital, personal, communication, R&D, market and even production-related relations (with short series, new products, one-off services, made to order, unique, etc.) are totally stretched out and blurred.

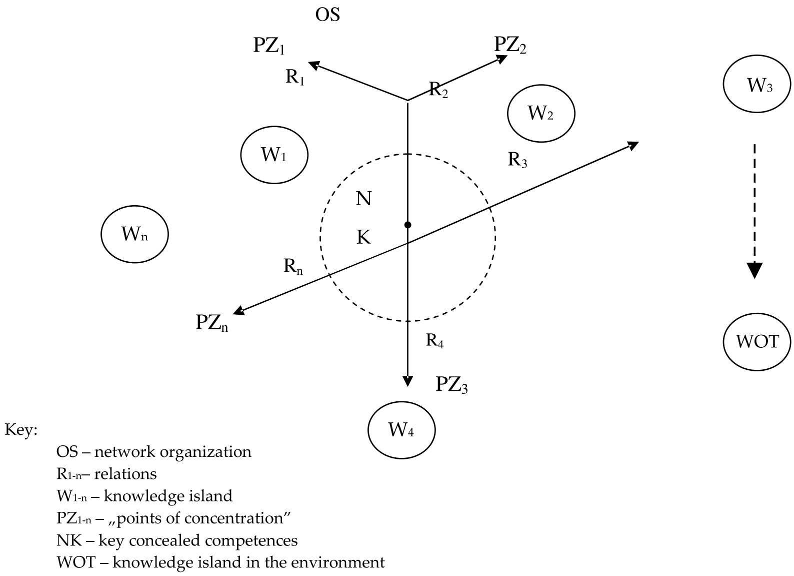

Figure 3. Centrifugal relations in a network organization

Source: Own elaboration.

The example presented above illustrates how the nature of relations alters from the employer – employee (superior – inferior) arrangement to the company – company arrangement, thereby causing:
– depersonalization of interpersonal contacts,
– increased intensity of negotiations and communication on the intangible value chain,
– atrophy of distinct decision-making centres,
– dispersion of informational assets and knowledge,
– increased difficulty of acquiring information and knowledge required.

The network organization model (figure 2) leads to the following conclusions:
– prevalence of centrifugal relational tendencies,

- the binding force is the concealed concentration of key competences (only for the "initiate", the "insiders": some of the company co-owners, key coaches and managers),
- oscillations on the relation lines are oriented towards "reaching" knowledge islands,
- the knowledge islands are subject to continual process of gaining autonomy, to complete separation from the network (e.g. W_3 in WOT).

The above implies that a network organization is a relational, ever expanding structure. The only way to prevent disintegration of a network of this type is permanent development of key knowledge (competence) redundancy.

3. Relational capital strategy in the process of organization virtualization

The context of relational capital role in gaining competitive advantage makes relational capital to be increasingly taken into consideration as an element of building the organizational strategy. Modern strategies emphasize the importance of the organizational actors co-operation. Another, very important cause of addressing relational capital in management strategies is the information and communication technology revolution, which depreciated the relevance of borders and geographical barriers to business activities [Castells, 2000, p. 18; Pańkowska, 2011, pp. 153–157].

An analysis of the business processes prospects and the way how technologies can be used to improve them reveals that the growth of organizations' competitive power should stem from optimization of internal business processes. Namely these processes should determine and build the organization's positive image and this in turn should translate directly into enhancement of the organizations' competitive advantage.

Figure 4 shows how the relational capital development adds to the competitive advantage growth.

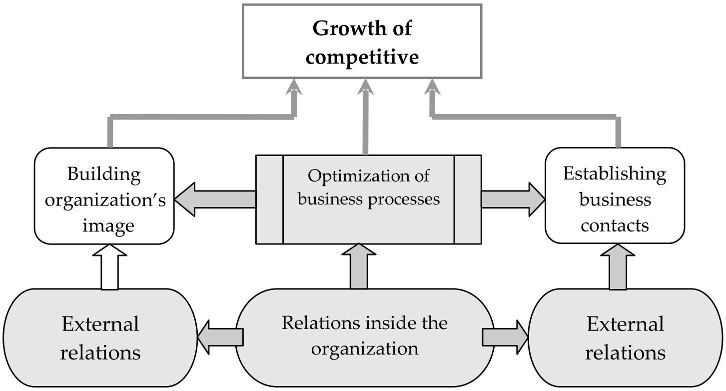

Figure 4. The role of relational capital in the growth of organization's competitive advantage

Source: Own elaboration.

Its is the context of situation that determines the extent to which various categories influence the relational capital value [Krupski, 2009, pp. 188–190]. Figure 5 shows the process of generating the organizational strategy of using relational assets in the context of subjective values that can be taken by categories characterizing various relations. The qualities of relations that should be filtered in the context of strategy development, are most typically connected with the high level of information exchange between the actors participating in these relations. Meanwhile, the relational strategy effectiveness depends on such determinants as trust and stability of relations, which can be achieved solely through equally strong commitment of all business actors to the relations they participate in [Czakon, 2010, pp. 16–21].

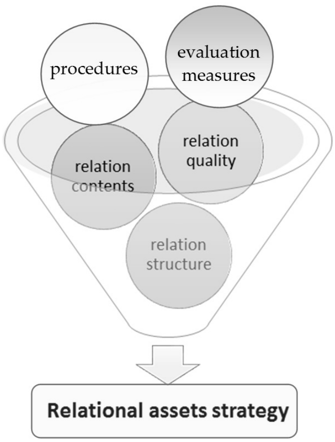

Figure 5. Filtering the key values that describe relations in the context of relational assets strategy development

Source: Own elaboration.

Using elements of the relational assets theory when developing the relational strategy, it is possible to describe and model each relation being established in the organization through the prism of such categories as:

- the actor participating in the relation,
- the purpose of the relation,
- the form of the relation [Wit 2007, pp. 217–249].

Hence, when developing the organization's strategy resulting from the relational assets theory, identification and analysis of stakeholders needs in terms of the relation purpose development should be taken as a starting point. Most typically, the following methods are used in the organization stakeholders analysis:

- the stakeholder map [Freeman, 1984],
- the M. Johnson and K. Scholes matrix [Johnson, Scholes, 1999],
- organization's key strategic partners profile analysis [Lisiński, 2004, pp. 86–87].

In modern, integrated IT systems, file directories containing information on organization's all stakeholder groups are created, thereby enabling initiation and intensification of activities contributing to development and strengthening of relations between the stakeholders and the organization. One of the most typical examples is sending birthday wishes to the organization's employees, as well as to its supplier or client contacts [Kasiewicz, Rogowski, Kiciński, 2006, p. 59].

To develop an effective strategy that will contribute to creating benefits resulting from development of relational capital, an organization needs to develop methods for identifying sources of this capital, as well as tools for measuring it. But in the business practice this is a serious problem, as no standards for measuring organizations' relational capital have been provided so far [Michalczuk, 2009, p. 71].

4. Process approach to relational capital management

Process approach is one of directions that can be chosen in relational capital management. The process approach idea in organizational management allows for a more precise focusing on selected processes of establishing, stabilizing, improving and evaluating relations.

Characteristics elements of process approach include customer focus, concentration on value-adding activities, elimination of activities that do not add value, as well as optimization of processes from the perspective of customer expectations. Each process should have its owner. Moreover, process approach develops and improves structures, thereby allowing for horizontal communication, going beyond functional areas whose role amounts to providing specialists in the task-related fields, while using relevant expertise and experience at the selected moment of the process implementation. [Cieśliński, 2011, p. 39].

The process approach concept is inseparable from organizational development towards process focus. It is defined as in internal manifestation of transformations enabling seamless transition of a functional organization, through process orientation, to event orientation. The organizational development cycle has three phases (figure 6):

1. Changes enabling transition from functional orientation to process orientations.
2. Changes enabling development and improvement of the process-oriented structures and management systems.
3. Changes enabling event orientation [Cieśliński, 2009].

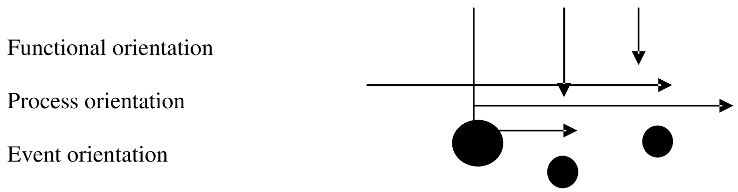

Figure 6. Company orientation models in theoretical terms
Source: [Cieśliński, 2009].

The use of process approach in relational capital management can multiply the effectiveness of organizational structures modelling. Preparing assumptions and guidelines for relations being established facilitates monitoring of both the centripetal and centrifugal effects caused by relational capital.

Conclusion

The purpose of the authors has been to emphasize the role of relational capital in processes of the modern organizational structures transformation. The considerations presented here cover the first stage of the research exploration planned by the authors. Linking up relational capital management with formation and improvement of organizational structures is a very innovative approach in the field of organizational management methods.

Hence, for the next stage, a survey in a selected group of companies is planned. The focus will be on identifying the relations between relational capital management and transformation of organizational structures.

Identification of the relational capital parameters determining transformation of organizational structures and their impact can become an extremely interesting field of study in the area of organizational management and improvement.

References

1. Castells M. (2000), *The Rise of the Network Society*, Blacwell Publishing, Oxford.
2. Chomiak-Orsa I. (2013), *Zaufanie w kontekście relacji międzyorganizacyjnych*, in: *Współczesne Problemy Ekonomiczne. Globalizacja. Liberalizacja. Etyka*, Wolska G. (ed.), Zeszyty Naukowe Uniwersytetu Szczecińskiego, Wydział Zarządzania i Ekonomiki Usług, Szczecin.
3. Cieśliński B.W. (2009), *Procesowa orientacja przedsiębiorstw – wyniki badań empirycznych*, in: Nowosielski S., *Podejście procesowe w organizacjach*, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław.
4. Cieśliński B.W. (2011), *Doskonalenie procesowej orientacji przedsiębiorstw: model platformy treningu procesowego*, Wydawnictwo Uniwersytetu Ekonomicznego, Wrocław.
5. Cygler J. (2009), *Kooperacja przedsiębiorstw. Czynniki sektorowe i korporacyjne*, Szkoła Główna Handlowa w Warszawie, Warszawa.
6. Czakon W. (2010), *Hipoteza bliskości*, "Przegląd Organizacji", nr 9.
7. Freeman R.E. (1984), *Strategic Management: A Stakeholder Approach*, Pitman, Boston.
8. Johnson G., Scholes K. (1999), *Exploring Corporate Strategy. Text and Casus*, Prentice Hall, London.
9. Kasiewicz S., Rogowski W., Kiciński M. (2006), *Kapitał intelektualny. Spojrzenie z perspektywy interesariuszy*, Oficyna Ekonomiczna, Kraków.
10. Klimas P. (2011), *Strategiczne znaczenie relacji z interesariuszami*; Wybór tekstów studentów studiów doktoranckich Uniwersytetu Ekonomicznego w Katowicach, PTE Oddział w Katowicach, Katowice.
11. Krupski R. (2009), *Strategie w języku zasobów*, in: Krupski R., Niemczyk J., Stańczyk-Hugiet E., *Koncepcje strategii organizacji*, PWE, Warszawa.
12. Lisiński M. (2004), *Metody planowania strategicznego*, PWE, Warszawa.
13. Michalczuk G. (2009), *Pomiar kapitału relacyjnego z perspektywy wewnętrznego zarządzania przedsiębiorstwem*, in: *Kapitał relacyjny w nowoczesnej gospodarce*, Cisek M. (ed.), Wydawnictwo Studio Emka, Warszawa.
14. Mikuła B. (2006), *Organizacje oparte na wiedzy*, Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków.

15. Malara Z. (2006), *Przedsiębiorstwo w globalnej gospodarce. Wyzwania współczesności;* Wydawnictwo Naukowe PWN, Warszawa.
16. Pańkowska M. (2011), *Modele i metody wspomagające zarządzania strategiczne technologią informacyjną*, in: *Informatyka Ekonomiczna*, Bytniewski A. (ed.), Zeszyty Naukowe Uniwersytetu Ekonomicznego we Wrocławiu nr 159, Wrocław.
17. Svendsen A. (1998), *The stakeholder strategy: Profiting from collaborative business relationships*, Berrett-Koehler Publishers, San Francisco.
18. Wit B., Meyer R. (2007), *Synteza strategii*, PWE, Warszawa 2007.

Chapter 10
The impact of IT Culture on IT Alignment

Dariusz Kralewski

Introduction

Technology is the fastest growing field today [Holtsnider, Jaffe, 2010]. Fusion of business and IT becomes a key issue for competitiveness. IT resources support the acquisition of information, its circulation, processing and exchange [Wrycza, 2011]. Without a properly tailored IT to the needs of company, it is not able to optimally achieve business objectives [Chan, Reich, 2007]. IT alignment is one of the domains of IT Governance [ISACA, 2005]. IT alignment in a number of scientific studies is associated with the IT Strategic Alignment. Authors in earlier works put attention to the fact that the IT Strategic Alignment is not enough. To complete fusion of business and IT it is necessary a high assessment of maturity at three levels – individual, operational and strategic. To simplify the interpretation of maturity on these three levels of introduced gradation – islands, recognition, collaboration, alignment and fusion. The combination of three levels with five named stages created (named by the authors) three-dimensional matrix of IT alignment. In this chapter the authors presents some mechanisms of bottom-up implementation of IT alignment.

1. Three levels of IT alignment

Benbya and McKelvey came up with a model which highlights the relevance of analyzing the relationship between Business and IT (Horizontal Alignment) but also the need to reconcile the views at different levels of analysis (Vertical Alignment). This model is shown in the enclosed. Further, they redefine alignment as follows: "Alignment is a continuous coevolutionary process that reconciles top-down 'rational designs' and bottom-up 'emergent processes' of consciously and coherently interrelating all components of Business/IS relationships at three levels of analysis (strategic, operational and individual) in order to contribute to an organization's performance over time" [Benbya, McKelvey, 2006].

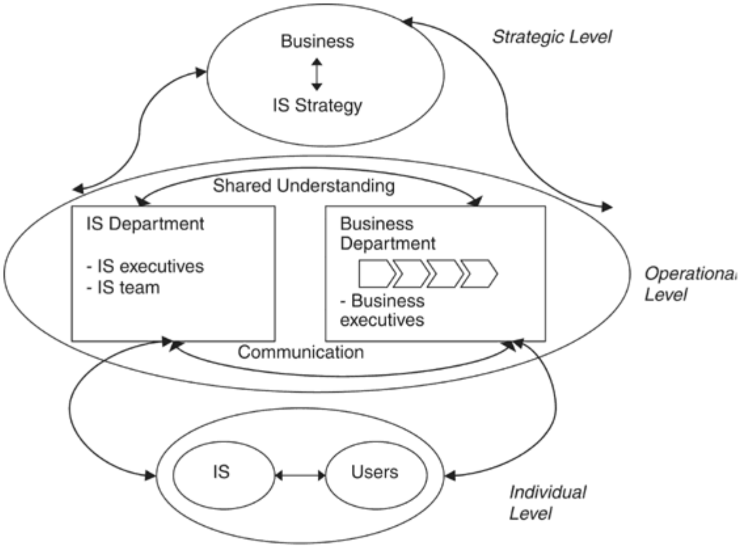

Figure 1. Coevolutionary IS Alignment

Source: [Benbya, McKelvey, 2006].

Their framework suggests the coevolution of IS with the organization at three levels:

1. Strategic Level – coevolving IS and business strategies. This cannot be achieved just by relying on top-down planning with little emphasis on the emergent nature and necessity of bottom-up planning for alignment.
2. Operational Level – coevolving IS and Business departments. Business managers and IS planners are unable to express themselves in common language. In short, they do not understand each other's complexities. Therefore, tightly aligned business and IS domains need continuous coordination and communication between the two poles of the duality, Business and IS. In order to achieve this, both Business and IS must form effective collaborative partnerships at all levels. Only through continuous adjustments between the two entities – Business and IS – alignment can be sustained.
3. Individual Level – coevolving IS infrastructure with individual users' needs. Users do not hold the same view of themselves that IS analysts do, and they do not like to be referred to as users. They do not even think of themselves as primarily having anything to do with the computer at all. They see themselves as professionals, working with others, and using computers in support of these interactions. Within a typical firm, individuals rarely have the opportunity to choose the system they use. As users become competent in using an IS, they often see new ways of doing things and dream up new things to do with the IS. These new ideas change the organization and its perception of what is re-

quired from its IS. If these changes cannot be easily incorporated in the IS, the users become frustrated and dissatisfied with the system. The reality is, that to derive its expected benefits and remain aligned with users need, the IS and its users must continually coevolve [Pettigrew, 2010].

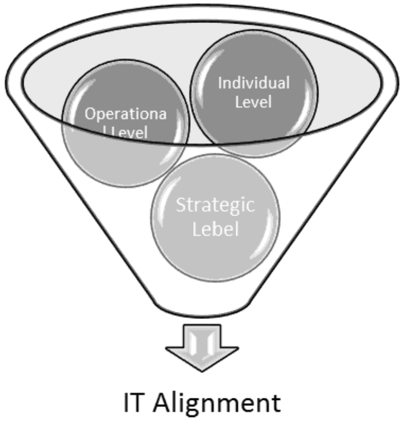

Figure 2. Three levels of IT alignment
Source: Own elaboration.

Maturity of the IT alignment is not just a strategic maturity. To speak about a full matching IT to the business we need to examine the level of alignment on three levels. The individual level in the author's opinion is of the most important level. Users are closest to their business processes. They know best how to support their task IT resources. The purpose of the IT department is, therefore, carefully listen to them and support end users / customers. This upward impulse moves to the next level - to support implementation of projects / portfolio of projects. The projects collected in a portfolio of projects can be linked together, or do not have nothing in common – their dependence on each other but sets out the fact that they share the same limited resources and are committed to foster and contribute to the strategic objectives of the institution. IT alignment at this point independently begins to function at the highest level (on which focuses the majority of scientific studies), the strategic level.

Examination the maturity of three specified levels it is therefore necessary to determine the maturity of IT. Of course, examine all IT alignment of the tasks is impossible. Analysis of the individual user opinion, however, gives us an outline of an overall assessment of IT alignment at the individual level. From conversations with individual users, outside evaluation, IT Management should gather articulated ideas and apply them to improve work efficiency and better IT alignment. Care must be taken about peace of mind of employees analyzed, so that at the time of the interview they were not afraid to present their views on current situations and creative ideas have reported improved functioning and support IT. Evaluation of IT alignment at the operational and strategic level direct is the responsibility of the IT manager, executive managers and supervisory boards. Evaluation of maturity at these levels seems to be easier to study than at the individual level. Developed for this purpose a lot of tools.

Figure 3. IT alignment matrix
Source: Own elaboration.

2. Bottom-up IT alignment

To say that the company is at a high level of IT alignment it should have a maturity "fusion" (or alignment) at all three levels. Having the highest level at the strategic level is not enough. IT culture must come from the bottom [Kralewski, 2012], and if the company has a "really live IT" and optimal use IT resources in the business it should provide the highest degree of maturity at all three levels of IT alignment.

2.1. DMC theories

Nobel Prize in 2010, with the economy received a Peter Diamond, Dale Mortensen and Christopher Pissarides [Nobel Prize, 2010]. The winners received the award for the analysis of the markets in which there are "friction" (markets with search frictions). Scientists have developed a theory that allows us to understand the impact on unemployment, wages and number of vacancies could have economic policies and regulations. They concluded that higher unemployment benefits result in higher unemployment and longer job search. To reduce the unemployment rate should give a better organization of individuals on recruitment and training. This theory can also be applied to other markets, such as real estate, may be used to include in monetary policy and regional issues.

This proven theory, in my opinion, perfectly complements the theories of IT alignment. They prove that top-down initiatives are less effective than working at the individual level. Rather than spend money on the sometimes artificial divisions and initiatives associated with the IT alignment it should allocate more funds for training and IT culture. It should also improve the means of communication so that information flow was faster and comprehensive. In this idea perfectly fits Enterprise 2.0.

2.2. Trainings

Training conducted in the company should be designed to not only improve the hard techniques of use IT resources, but also should include soft aspects such as creative thinking, communication, knowledge management, etc. Increased knowledge users about IT systems makes:
- a better use of existing IT resources,
- psychological increase its own value in IT matters (no sense of fear regarding IT and the mental state of an expert in matters relating to IT),
- a creative approach to problem solving using IT tools,
- no afraid to share their ideas on the use of IT resources with other employees and managers
- IT better fit for future activities by prompt users of IT resources,
- users through self-development, the test of environment are able to give original ideas that did not come to think of management and board of directors,
- improved resource efficiency – better motivation – in determining of IT resources were taken into account the opinion of users,
- better decisions and better fit the IT strategy – greater number of experts (business + IT department + users) are able to make better decisions.

2.3. Enterprise 2.0

Enterprise 2.0 is a new approach in which companies are beginning to provide their employees fast, easy to use social networking tools – so that those work more efficiently, creatively, pleasantly. All provided in a manner known with the GoldenLine, Facebook and Wikipedia [Casarez, Cripe, Sini, Weckerle, 2008]. The effectiveness of platforms based on Web 2.0. determine three key elements.

The first element is business pulse energy. It all starts with a specific impulse business, which is important for both regular employees and for the Board. A specific goal (challenge) is published on a platform 2.0. and becomes the spark for energy cooperation and joint development of solutions.

The second element is a healthy, unromantic innovation: the creation and improvement ideas. Employees and teams are induced in various ways to share good practices in this area (e.g. competitions, through the prestigious title of expert for the most active employees, etc.). It is important that ideas and best practices are rarely published in text form (people do not like to take notes). The system should allow for example, jump start web cam, which allows for 3 minutes convincingly tell the story of applied solutions [McAfee, 2009]. Registered ideas are available on-line for all other users who can comment on them right away, supplement, or even evaluate with a star (like, for example multimedia assessed on YouTube or books in online stores). The emerging ideas of other workers tend not to remain behind and also praised their solutions.

The third element is the emergence and recommending best practices. The ratings and comments makes it possible to very easily identify the ideas, most viewed, top rated and most valuable of the implementation. It is noteworthy that in the community 2.0. all staff (and therefore the whole community) are the jurors ideas that can help them in achieving the objectives. So here goes outdated model of "competition for innovation" and abstract, invisible "jury" that every few months is collect, to evaluate ideas, falling down to the mailbox. Moreover, the platform 2.0. gives decision makers an opportunity to give a distinctive practices and ideas of the status of recommended practices. This means that as a result of certain groups of employees will be accounted by the managers of their use.

It is worth noting that the events in community building platforms 2.0. in the company are not "incidental". Movement is done on them 24 hours a day, ideas and best practices are declared non-stop [Tapscott, 2010]. Employees can simultaneously share their ideas and concerns regarding the number of business priorities. In addition, regularly appears in a portion of solutions and best practices from outside – from leaders in other industries or from abroad. These external practices and cases are edited by a team of editors and those caring for these platforms.

The effect of building community 2.0 is the overall business climate in a constructive, business "game pads" – elements of valuable business knowledge. Each employee has the feeling that he has a chance to co-create business success, more and better understand the mechanisms governing the market, besides discovering the joy of successful struggle for the market – including, above all for the hearts and wallets of customers.

2.4. Leadership philosophy

Nowadays, business organizations are increasingly the challenges of a changing turbulent environment. Fewer and fewer companies operating in stable environments. This situation causes the increased need for effective leadership. Of course, always been like that for the success of the organization was needed a leader, but the need is becoming even more urgent in today's environment. Organizations often become almost dependent on effective leadership.

Definition of this type can be found very much. Initially, the leadership issue dealt mainly with sociology and political science. Investigated this issue primarily in terms of social and political leadership, linking it with the problem of power, giving as one of the aspects of power [MacGregor, Burns, 1994]. Hence, leadership is the ability to influence or exercise of power in social communities [Abercrombie, Hill, Turner, 1988], the power of one or more persons to influence the group and to adapt their policies [Bogdanor, 1993].

Leadership can be defined, however, more generally, applying them to business organizations. According to Morris and Seem [Morris, Seeman, 1959], the leadership is any activity that affects the attitude of the group. The authors do not consider here the way and the source of that influence.

According to Burns [Janda, 1960] and we can talk about leadership when leaders followers thanks to seek targets that represent the values and motivations of common one and the other, the objectives of the group or organization. The whole art of leadership is based on demonstrating and implementing the common goals, the realize the potential inherent in other people and managing talents, knowledge and capacities of a group toward predetermined results. The leadership as a process involves using influence without resorting to coercive measures. Its purpose can also define the culture of the group or organization [Yukl, 1989]. This definition seems to prevail in the modern sense of economic leadership. Objectives are derived not only from the leader, but are the result of its goals and objectives of the group. The leader is responsible for developing and implementing a vision that will survive and grow the organization in a turbulent market [Lambert, 1999].

Charles Manz and Henry Sims, in his book "Superleadership" go even a step further. They introduce the concept of superleader as "a person who leads others to themselves engaged" [Manz, Sims, 2009]. Its impact is difficult to spot, but necessary. The leader inspires, motivates, encourages [Wildavsky, 1994]. Often people are led in today's business organizations have much more knowledge, they are professionals and experts. They have the potential to alter reality. They need only a catalyst that will allow them to unleash their own potential. Such a catalyst has to be just a modern leader.

3. IT culture

For a description of the phenomenon currently known as the organizational culture uses the term "organizational climate". The concept of organizational culture introduced to the scientific literature A.M. Pettigrew [1979]. Constructing it explicitly refers to the wider culture and assumes that each organization creates its own specific culture, that is, the space in which individuals communicate and carry out tasks, while gaining a sense of identity. Organizational culture describes: symbols, myths, rituals, values and norms. In the literature on leadership, we find many references to the culture of the organization. These publications, however, does not consent to it, with what the culture is.

Because culture reflects the wishes of a particular group to integrate, the concept of organizational culture refers to the organization that has a stable structure, a particular set of values and rituals of the most articulated in the process of communicating internally and externally. Of course, group cohesion is sometimes variable. Volatility is here an indicator of the organizational culture of subordination to the national culture – despite the individuals' identification with the organization and the emerging element of loyalty to the employer, the members resign from membership of the organization under the influence of different factors that, in consequence, the "enter" the culture of another organization. Therefore there is no reference or references to patriotism, the concept of cultural heritage, nor the continuity of tradition in relation to individuals.

According to the work E.H. Schein [Dries, 1992], organizational culture may be strong or weak, internally consistent or varied. The consistency and strength of the group and its culture depends on: the definition of group boundaries, how to divide power and influence, develop appropriate relationships between group members to establish a code of conduct, a system of social control, forms of rewards and punishments, and to construct a kind of mythology of the organization.

Many authors dealing with the issue of organizational culture believes that one of the most important functions of leadership is the management culture. Avery, relying on research conducted in companies Bonduelle, Gore, Rodenstock, and Swatch, points out that leaders act as role models for other members of the organization and even when the leader is gone, his memory is perpetuated in the form of stories and myths about him, and inputted by the change in the style of communication and behavior remain even when the leader leaves the organization. Subordinates may follow their leaders, deciding at the same time, what behaviors are acceptable and which is a symbol of status within that culture. In organizations with a strong culture, the new leaders do not create culture from the beginning, however, must adapt to that which currently exists [Avery, 2009].

An important issue is what kind of behavior members of the group (organization) consider it as "leadership". Very much depends on what are their ideas, expectations and experiences of leadership. Perception, acceptance or negation of leadership depends on the parent culture to organizational culture that is national culture. It is therefore important to prepare for functioning in a multicultural environment where the assumptions of particular organizational cultures overlap in the determinants of behavior, attitudes and values relating to national and ethnic identification.

IT culture is closely linked to organizational culture. This transfer of organizational culture on the level of IT. IT culture so are the symbols, myths, rituals, values and standards relating to the operation of IT within the company. IT culture is in any business. The improvement of IT Culture is in the interest of the company. IT Culture is aware of IT, IT processes, understanding the impact of IT on individual action and strategy of the company. IT culture is a “feeling of computer science”. IT culture create users – not just IT department but all of them. IT culture should “look after” the IT manager.

Conscious creation (improvement) of IT culture is the impact on stakeholders such as employees, users / customers, partners, through:

- thought out program of training, program information,
- supporting communication channels and knowledge management tools within the framework of Enterprise 2.0,
- philosophy of leadership.

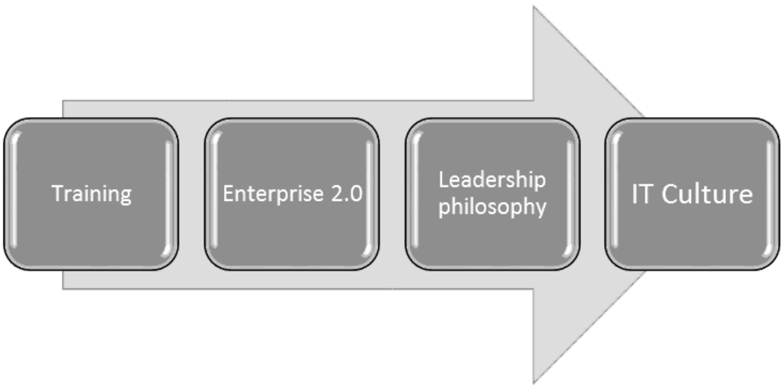

Figure 4. Elements that create IT Culture

Source: Own elaboration.

Approaches to IT leadership needs to be improved. However, can not do so until there is a change of mentality and training of employees, and Enterprise 2.0 does not become part of the new philosophy. These factors are equally important. Their complementary development reinforces the IT culture and IT alignment.

Many companies set up programs for training in leadership. This does not mean the creation of philosophy of leadership. It is important that every employee was aware of changes in management style and decision-making process from the “command and control” to “cooperation” [Woźniak, 2012]. It is important to realize that in the company every opinion is important, every opinion influences the decisions, every employee is a “leader”. This approach does not necessarily mean flattening the organizational structure. The role of management is to prevent lock of decision, delaying decisions, resolve conflicts, etc. Changing the philosophy means greater openness of workers, establishment of closer relationships, increased creativity, better performance and thus improve the standing of the company.

Conclusion

Companies without a properly tailored IT to its strategy are not able to function in a competitive market. That adjustment is now seen as a strategic element of the company. This leads to generate a large number of policies and procedures.

The insertion of appropriate IT governance procedures is not enough. Bottom-up rules based on training, enterprise 2.0 and philosophy of leadership create a culture of IT, which is a guarantee of understanding and application of information governance.

References

1. Abercrombie N., Hill S., Turner B. S. (1988), *The Penguin dictionary of sociology*, Penguin Books.
2. Avery G. (2009), *Leadership in organizations*, PWE, Warszawa.
3. Benbya H., McKelvey B. (2006), *Using coevolutionary and complexity theories to improve IS alignment: a multi-level approach*, "Journal of Information Technology", Vol. 21.
4. Bogdanor V. (red.), (1993), *The Blackwell Encyclopedia of Political Science*, Blackwell Publishers, Oxford, Cambridge.
5. Casarez V., Cripe B., Sini J., Weckerle P. (2008), *Reshaping Your Business with Web 2.0: Using New Social Technologies to Lead Business Transformation*, McGraw-Hill Osborne Media.
6. Chan Y.E., Reich B.H. (2007), *IT Alignment: An annotated bibliography*, "Journal of Information Technology", Vol. 22.
7. Dries E.H. (1992), *Organizational Culture and Leaderschip*, Jossey-Bass, San Francisco.
8. Holtsnider B., Jaffe B. (2010), *IT Manager's Handbook The Business Edition*, Morgan Kaufmann.

9. IT Governance Institute (2005), *IT Alignment: Who Is in Charge?*, http://www.isaca.org/Knowledge-Center/Research/Documents/IT-Alignment-Who-Is-in-Charge.pdf, ISACA.
10. Janda K.F. (1960), *Towards the Explication of the Concept of Leadership in Terms of the Concept of Power*, "Human Relations", vol. 13.
11. Kralewski D. (2012), *Bottom-up decentralized approach to innovation strategy, New Generation Enterprise and Business Inno-vation Systems*, CAiSE, Springer.
12. Lambert T. (1999), *Problemy zarządzania. 50 praktycznych modeli rozwiązań*, Dom Wydawniczy ABC, Warszawa.
13. MacGregor Burns J. (1994), *Władza przywódcza*, in: *Władza i społeczeństwo*, Wydawnictwo Naukowe Scholar, Warszawa.
14. Manz C., Sims H. (2001), *The New Superleadership: Leading Others to Lead Themselves*, Berrett-Koehler Publishers.
15. McAfee A. (2009), *Enterprise 2.0: New Collaborative Tools for Your Organization's Toughest Challenges*, Harvard Business School Press.
16. Morris R., Seeman M. (1959), *The Problem of Leadership: An Inter-Disciplinary Approach*, "American Journal of Sociology", Vol. 56.
17. Nobel Prize (2010), *The official Web Site of the Nobel Prize*, http://www.nobelprize.org/nobel_prizes/economics/laureates/2010/press.html.
18. Pettigrew A.M. (1979), *On studying organizational cultures*, "Academy of Management Review" [AMR], Vol. 24.
19. Tapscott D., Williams A. (2010), *Wikinomics: How Mass Collaboration Changes Everything*, Portfolio Trade.
20. Wildavsky A. (1994), *Kulturowa teoria przywództwa, we Władza i społeczeństwo*, Wydawnictwo Naukowe Scholar, Warszawa.
21. Woźniak M. (2012), *The Innovative Potential and Problems of the Modern IT Projects, New Generation Enterprise and Business Inno-vation Systems*, CAiSE, Springer.
22. Wrycza S. (red), (2011), *Informatyka ekonomiczna. Podręcznik akademicki*, PWE.
23. Yukl G.A. (1989), *Leadership in Organization*, ed. 2, Prentice-Hall, Englewood Cliffs, New York

Chapter 11

Comparison of the technical efficiency of banks with measures of the effectiveness of spending on information technology – the use of Malmquist index

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Introduction

Data Envelopment Analysis is a well-recognized method of performance analysis and modeling of the organization and operational processes, in particular in situations where market prices are unknown or difficult to estimate. DEA is a nonparametric and deterministic method, based on non-linear programming. In the banking sector DEA method is often used to study the effectiveness of both branches of the bank and the banks, as companies. A commonly used approach in the studies is to treat the bank, as the classical producer, with capital and employees – as major inputs. Malmquist index is based on the concept of DEA efficiency ratio, and its decomposition was proposed for the first time at work [Fare et al., 1994].

DEA models used to determine the Malmquist index can be oriented for input or output. Therefore, radial Malmquist index (MI) used in this chapter can be similarly interpreted due to the orientation of the model[1]. When MI is a output-oriented, determined current levels of inputs, in the case of orientation MI for inputs determined levels of inputs have to be establish. Malmquist index can be decomposed into two elements, first related to changing technological frontier and second related to efficiency of the objects (banks). Malmquist index enables the measurement of technical progress associated with changes in the production process or/and implementation of best practices in the industry, or/and changes related to the introduction of new technologies. On the other hand, the increase in "self-driven efficiency" of the object is associated with improved own capacity. Some companies are able to use more efficiently existing technology, previously introduced by other companies in the same industry. This growth is accompanied by such factors as changes in productivity, improved learning or management practices.

[1] Similarly as in the method of DEA, Malmquist index may use radial or non-radial method for determining the efficiency of production capacity relatively to production frontier of banks.

1. Objectives of research and hypotheses

A goal of comparative study of efficiency is to assess the overall productivity of banks in the years 1998 to 2008[2]. It should be noted that at the end of this period process of consolidation of the banking sector in Poland faded out and it had not yet felt the impact of the financial crisis beginning of 2009. For this reason, eleven-year follow-up period was relatively stable, except for the years 2002–2003, when Poland experienced a moderate economic slowdown. The second objective of the study is to propose a relatively simple model for the assessment of banks in terms of their growth and productivity. The decision to use the study Malmquist index has a double justification. Malmquist index enables the analysis of a bank's performance measures against the others in a comparable environment and market conditions. On the other hand, a comparison to the previous period is „forced" on the examined object to compare „to himself". At the same time for all banks the overall technological progress is used to compare banks as group. It is not enough, to be the chosen to be the best in a given year; such a requirement must be met in subsequent years.

The study adopted the following two main hypotheses:

H1: The total efficiency of banks has improved over the period considered.

H2: There is a relationship between measures of overall performance of the bank and spending on IT (in the sense of Malmquist TFP)

Studies using Data Envelopment Analysis method first have to determine the measure of efficiency tested objects against the whole group of objects. The study group should meet a number of conditions, of which the condition of sample homogeneity is most important and critical. Banks tested in this study, are universal banks, pursue the same business objectives and offer similar products and banking services. Relative effectiveness measurement (DEA method) allows comparison of the best bank of the group to effectiveness of reminding banks. DEA method is a nonparametric and deterministic method, where the optimization problem is to solve the non-linear equation for each tested object. There are many models DEA, although in practice, only few of them are used[3]. The most popular are the CCR and BCC models[4] (often called classic). Popularity DEA method in studies of banks come from its versatility in the analysis of complex production systems, where there are many factors affecting production results. In such a situation it is difficult to determine the direct effect of individual input factors on the results.

[2] The choice of the periods depended on the availability of data. The period range does not include years of financial crisis and the unusual behavior of the banks.

[3] The full description of the methods and models of DEA can be found in [Cooper, Seiford, Tone, 2007].

[4] Name of CCR and BCC models comes from first letter of names – authors who formulated the conditions for the optimization dilemma.

A special case of the relative efficiency analysis for a single observed bank is to compare and analyze the efficiency ratio observed for two consecutive periods, usually annual. They usually based on the CCR model of DEA method. Changes in the efficiency of the object (bank) (called in the literature, in this case also as – productivity) between consecutive periods, we evaluate the use of so-called, “Malmquist index”.

The idea of the productivity index is to measure the levels of productivity of the unit at time t and t + 1. Level of productivity for period t is at the same time considered mostly as a reference point. That means the measurement of productivity at time t + 1 takes place against the background of productivity at time t. Popularity Malmquist productivity index is the most important because of the close relationship with the DEA method, allowing for the use of the advantages of this method[5].

Malmquist index value represents the change in the productivity of the production unit (the bank) in time.

If the index value is greater than 1, it is assumed that during the period of time t +1 with respect to t there was a relative increase in productivity, while an index value less than 1 indicates a decrease in productivity, and the value of 1 indicates the persistence of the level unchanged.

The original version of the Malmquist index assumed that Decision making Units (banks) to be tested, moving on the lines which represent their production capacity, shown in figure 1. This assumption automatically excludes consideration of the technical inefficiency of the tested objects. This definition reduces the possibility of interpretation for calculated results, because it does not provide any guidance on the causes of fluctuations in productivity. Therefore Malmquist index has been modified and designed to isolate certain elements of productivity.

Malmquist index in modified form consists out of two components. The first element is measured technical progress (technical change, frontier-shift), a relative shift in production possibilities frontier observed for the whole set, the second factor is the ratio of technical efficiency (efficiency change, technical efficiency change), i.e. linear distance from the boundary line of production capacities of decision units. In this way, increase productivity index value is possible even if one element is in decline, provided, however, that it is compensated by the increase of the second element.

5 Near a half of the studies on the effectiveness of banks using nonparametric methods, the most common method is DEA.

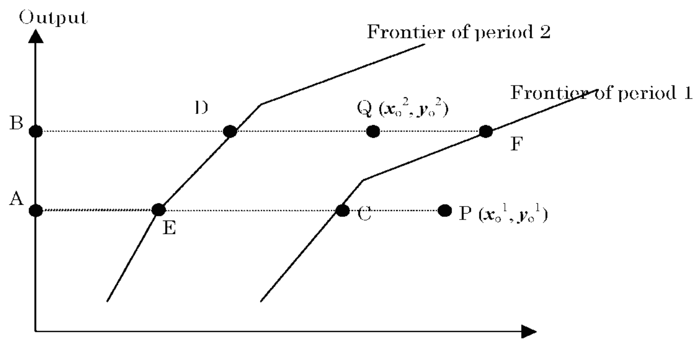

Figure 1. Graphical illustration Malmquist index definition
Source: User's Guide to DEA – Solver Pro, ver.7.0 p.35.

Malmquist Q factor for object shown in Figure 1 is defined as the product of two factors: the rate of technological progress (Catch-up) and the coefficient of technical efficiency change of the object (Frontier-shift).

Effect of changes in technical efficiency for a given object Q, assuming oriented model inputs, can be calculated as follows:

$$\text{Catch-up} = \frac{\text{Efficiency-of } (x_0^2, y_0^2) \text{ with} - \text{respect to period 2 frontier}}{\text{Efficiency-of } (x_0^1, y_0^1) \text{ with} - \text{respect to period 1 frontier}}$$

$$\text{Catch-up} = \frac{\frac{BD}{BQ}}{\frac{AC}{AP}} \qquad (1)$$

(Catch-up) > 1 indicates progress in relative efficiency from period 1 to 2,

(Catch-up) = 1 indicates status quo

(Catch-up) < 1 indicates regress in efficiency.

In addition to the catch-up term, we must take account of the frontier-shift effect in order to evaluate totally the efficiency change of the DMU, since the catch-up is determined by the efficiencies as measured by the distances from the respective frontiers.

The reference point C of (x_0^1, y_0^1) moved to E on the frontier of period 2. Furthermore the Frontier-shift effect at C (x_0^1, y_0^1) is evaluated by:

$$\varphi_1 = \frac{AC}{AE} \qquad (2)$$

$$\varphi_1 = \frac{\frac{AC}{AP}}{\frac{AE}{AP}} = \frac{\text{Efficiency of } (x_0^1, y_0^1) \text{ with respect to period 1 frontier}}{\text{Efficiency of } (x_0^1, y_0^1) \text{ with respect to period 2 frontier}} \tag{3}$$

The denominator is measured as the distance from the period 2 production possibility set to C (x_0^1, y_0^1).

Likewise, the Frontier-shift effect at (x_0^2, y_0^2) is expressed by the frontier-shift effect is described as

$$\varphi_1 = \frac{\frac{BF}{BQ}}{\frac{BD}{BQ}} = \frac{\text{Efficiency of } (x_0^2, y_0^2) \text{ with respect to period 1 frontier}}{\text{Efficiency of } (x_0^2, y_0^2) \text{ with respect to period 2 frontier}} \tag{4}$$

Frontier-shift can be defined by their geometric mean as:

$$\textit{Frontier-shift} = \varphi = \sqrt{\varphi_1 \varphi 2} \tag{5}$$

Malmquist index is obtained as the product of (Catch-up) and (Frontier-shift). The total Malmquist index is defined as

Malmquist index (TFP)[6] = **(Catch-up) × (Frontier-shift).** (7)

It is an index representing Total Factor Productivity (TFP) of the DMU, in that it reflects progress or regress in efficiency of the DMU along with progress or regress of the frontier technology.

Malmquist index > 1 indicates progress TFP of the DMU from period 1 to 2,
Malmquist index = 1 indicates the status quo
Malmquist index < 1 indicates the decoy of total factor of productivity.

The MI can by compute in number of way using different Malmquist models. In this chapter results are presented based on non-radial Malmquist model input oriented with constant return of scale assumption.

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6 Total Factor Productivity.

2. Data sources and measurement model

The data for test the effectiveness of universal banks comes from several sources. These are: Annual Report Monthly Bank „of the 50 largest banks in Poland" in 1998–2008, annual reports of banks listed on the Warsaw Stock Exchange and published on the company's IT expenditures on DiS[7]. In case of discrepancies adopted Annual Report of the Bank as the most reliable source. In order to ensure that the condition of homogeneity of the study group, the study included only universal banks, this has been on the market during the whole study period.

In the case of mergers or acquisitions, the rule has been adopted to combining inputs and outputs in the year preceding the merger. The study used the production profile of bank.

That means the following inputs has been used: operating expenses, number of employees and deposits of non-financial sector.

Finally, the study used data from the 17 largest universal banks, which in different years were 80–85% of the Polish banking sector, in terms of asset size. The study does not include banks that do not meet the criteria of homogeneity of the sample, for example, omitted the Bank of National Economy (BGK), Mortgage Banks, etc.

Malmquist index was calculated based on the CCR[8] model of DEA-oriented investments with fixed effects of scale. Such a choice is dictated by the adoption of the assumption that if a comparison of the effectiveness of individual banks based on two elements, a factor changes the size of the organization is already included. It is compatible with the work [Grifell-Tatje, Lovell, 1995], which shows that the variables create economies of scale factor Malmquist inadequate size.

The effectiveness of the bank was examined by adopting the following inputs and outputs for the bank type "producer":

Inputs: Employment (full-time employees), Operating cost of the bank

To test the effectiveness of the two profiles, the following results have been chosen: **Outputs; Deposits – Deposits from non-financial sector loans – receivables from customers, net income from banking operations**[9].

It worth to be noted that outputs of both models are the same to ensure comparable targets for both research models.

In the tables showing the results of the study, the values below 1 are highlighted in grey. Table 1 shows the values of overall efficiency (technological prog-

7 DiS publications on banking IT concern, therefore, been chosen as the primary data source. The company uses the same method for the classification of expenditures on IT for many years. Similar data can be found in IDC Central Europe.

8 CCR model name comes from the names of the authors of this model: Charnes, Cooper, Rhodes.

9 Net results of banks has been used due to the different levels of taxation for individual banks, dependent on other factors and changing over time.

ress – catch-up) in the of Polish banks. In 1998–2003, the coefficient of technological progress for the 26 banks is below 1, which means regression in effectiveness.

In 2003–2008, the number of banks with a ratio less than unity increased to 34 which means that in the first half of the reporting period was observed greater technological progress. The worst situation occurred in 2005–2006 and 2006–2007. In these years, number of banks that experienced a decrease in efficiency was the highest during the period, respectively 9, 10 banks.

Quite different results, changes in technical efficiency ratio (Frontier-shift) can be seen in table 2, showing the value of this ratio. Technical efficiency of banks was much worse in the first four years. As many as 50 banks for the technical efficiency ratio during this period was less than 1.

In 1999–2000, all banks existed regression, with an average of 0,81 for the entire study group. In the years 2003–2008 there was a significant improvement in the situation, because the number of banks with a ratio below unity decreased to 17 in the years 2002–2003, 2004–2006 and 2007–2008 rate of technical efficiency for all banks is above 1. The combination of analysis results of tables 1 and 2 makes it possible to interpret the results Malmquist index values shown in table 3 – Malmquist index is the product of two factors – the efficiency presented in tables 1 and 2. Table 3 can be easily seen (check the color grey), the number of banks characterized by Malmquist index value less than 1 is much higher in the first 5 years of the period. Such cases is 40 in the second half of the number of banks inefficient from the standpoint of Malmquist index is much smaller and is only 20.

Table 1. Index Catch-up for efficiency of banks

Catch-up	1998=>19	1999=>20	2000=>20	2001=>20	2002=>20	2003=>20	2004=>20	2005=>20	2006=>20	2007=>20	Średnia
PKO Bank Polski S.A.	0,93	1,28	1,20	0,89	1,17	1,00	0,78	0,87	0,69	1,00	0,98
Bank Polska Kasa Opieki S.A.	0,91	1,45	1,01	1,00	0,90	0,96	0,87	1,09	0,98	0,87	1,01
Bank BPH	1,00	0,90	0,85	1,08	1,06	1,15	0,97	0,95	1,09	1,00	1,00
ING Bank Śląsk S. A.	1,19	1,29	1,01	1,02	1,05	1,05	1,00	1,00	1,00	0,88	1,05
Bank Handlowy S.A.	1,12	1,16	1,01	1,00	0,95	0,87	0,87	0,67	1,26	1,10	1,00
Bank BGŻ	1,06	1,15	1,12	1,09	0,76	1,09	1,03	0,83	0,97	1,07	1,02
Raiffeisen Bank Polska SA	1,28	1,14	0,91	0,99	1,09	1,01	0,94	1,06	1,00	1,09	1,05
BRE Bank S.A.	1,10	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,01
Bank Zachodni BZWBK	1,00	1,00	0,65	1,12	1,01	1,19	1,13	0,85	0,81	1,11	0,99
Kredyt Bank	1,21	1,20	0,97	1,25	0,63	1,06	1,01	0,95	0,91	1,22	1,04
Bank Millennium	1,82	0,88	0,86	0,97	0,96	1,27	1,15	0,75	0,91	1,09	1,07
Bank Ochrony Środowiska	1,04	1,10	0,84	1,13	0,71	1,21	1,22	0,86	0,99	1,10	1,02
NORDEA Bank Polska	1,07	1,17	1,05	0,92	1,56	1,04	1,08	1,02	1,00	0,94	1,09
LUKAS Bank S A	0,65	1,32	1,16	1,00	1,00	1,00	0,38	1,60	0,52	0,82	0,95
Fortis Bank Polska	1,00	1,00	0,91	1,10	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Invest - Bank SA	1,24	1,07	1,19	0,98	0,88	0,99	0,90	1,27	0,58	0,57	0,97
GETIN BANK SA	1,11	1,35	1,15	1,00	0,43	2,30	0,89	0,82	0,85	1,60	1,15
Średnia	1,10	1,14	0,99	1,03	0,95	1,13	0,96	0,98	0,92	1,03	1,02
Wartość maksymalna	1,82	1,45	1,20	1,25	1,56	2,30	1,22	1,60	1,26	1,60	1,15
Wartość minimalna	0,65	0,88	0,65	0,89	0,43	0,87	0,38	0,67	0,52	0,57	0,95
Średnie odchylenie	0,24	0,16	0,15	0,09	0,24	0,32	0,19	0,21	0,18	0,21	0,05

Source: Own calculation.

Table 2. Index Frontier-shift for efficiency of banks

Frontier	1998=>19	1999=>20	2000=>20	2001=>20	2002=>20	2003=>20	2004=>20	2005=>20	2006=>20	2007=>20	Średnia
PKO Bank Polski S.A.	0,94	0,88	0,89	1,04	1,42	0,81	1,01	1,12	1,49	1,03	1,06
Bank Polska Kasa Opieki S.A.	0,99	0,81	1,06	0,99	1,03	0,98	1,24	1,05	1,21	1,07	1,04
Bank BPH	1,22	0,76	1,08	0,97	1,10	0,98	1,19	1,13	1,92	1,22	1,16
ING Bank Śląsk S. A.	0,94	0,77	1,00	0,90	1,08	1,07	1,25	1,01	1,03	1,13	1,02
Bank Handlowy S.A.	0,87	0,80	1,06	1,06	1,03	1,08	1,65	1,07	0,77	1,12	1,05
Bank BGŻ	0,89	0,81	0,95	0,99	1,27	0,94	1,01	1,36	1,18	1,05	1,04
Raiffeisen Bank Polska SA	0,96	0,91	1,09	1,00	1,15	1,08	1,35	1,12	0,86	1,12	1,06
BRE Bank S.A.	1,07	0,65	1,08	0,99	1,26	1,00	1,40	1,19	0,82	1,09	1,06
Bank Zachodni BZWBK	1,05	0,87	0,83	0,96	1,11	1,00	1,12	1,15	1,15	1,09	1,03
Kredyt Bank	0,95	0,82	1,03	0,83	1,35	0,97	1,25	1,04	1,06	1,11	1,04
Bank Millennium	0,91	0,77	1,07	1,00	1,12	1,02	1,26	1,07	1,11	1,15	1,05
Bank Ochrony Środowiska	0,90	0,86	0,99	0,85	1,50	0,87	1,08	1,33	1,11	1,10	1,06
NORDEA Bank Polska	0,93	0,85	0,95	0,83	1,45	0,88	1,14	1,74	0,88	1,17	1,08
LUKAS Bank S A	0,69	0,71	1,09	1,07	1,08	1,08	1,05	1,07	1,82	1,27	1,09
Fortis Bank Polska	0,77	0,92	1,08	0,98	1,19	0,91	1,14	1,84	1,00	1,35	1,12
Invest - Bank SA	0,88	0,82	0,94	0,95	1,09	0,96	1,08	1,17	1,96	0,96	1,08
GETIN BANK SA	0,90	0,78	1,04	0,96	1,06	0,97	1,01	1,43	1,17	1,19	1,05
Średnia	0,93	0,81	1,02	0,96	1,19	0,98	1,19	1,23	1,21	1,13	1,07
Wartość maksymalna	1,22	0,92	1,09	1,07	1,50	1,08	1,65	1,84	1,96	1,35	1,16
Wartość minimalna	0,69	0,65	0,83	0,83	1,03	0,81	1,01	1,01	0,77	0,96	1,02
Średnie odchylenie	0,12	0,07	0,08	0,07	0,15	0,08	0,17	0,24	0,37	0,09	0,03

Source: Own calculation.

Table 3. Malmquist index for bank efficiency

Malmquist	1998=>19	1999=>20	2000=>20	2001=>20	2002=>20	2003=>20	2004=>20	2005=>20	2006=>20	2007=>20	Średnia
PKO Bank Polski S.A.	0,87	1,13	1,07	0,93	1,65	0,81	0,79	0,97	1,02	1,04	1,03
Bank Polska Kasa Opieki S	0,90	1,17	1,08	0,99	0,93	0,94	1,09	1,14	1,18	0,94	1,04
Bank BPH	1,22	0,69	0,92	1,05	1,16	1,13	1,15	1,08	2,08	1,22	1,17
ING Bank Śląsk S. A.	1,11	0,99	1,02	0,92	1,14	1,12	1,25	1,01	1,03	0,99	1,06
Bank Handlowy S.A.	0,98	0,93	1,07	1,06	0,99	0,94	1,44	0,71	0,97	1,23	1,03
Bank BGŻ	0,94	0,93	1,06	1,08	0,96	1,02	1,05	1,13	1,14	1,13	1,04
Raiffeisen Bank Polska SA	1,23	1,04	1,00	0,99	1,26	1,09	1,27	1,18	0,87	1,22	1,11
BRE Bank S.A.	1,19	0,65	1,08	0,99	1,26	1,00	1,40	1,19	0,82	1,09	1,07
Bank Zachodni BZWBK	1,05	0,87	0,55	1,08	1,12	1,19	1,27	0,98	0,94	1,21	1,03
Kredyt Bank	1,15	0,99	0,99	1,04	0,85	1,03	1,26	0,99	0,96	1,35	1,06
Bank Millennium	1,65	0,67	0,92	0,98	1,08	1,30	1,45	0,81	1,01	1,25	1,11
Bank Ochrony Środowiska	0,93	0,95	0,83	0,96	1,07	1,06	1,32	1,14	1,10	1,21	1,06
NORDEA Bank Polska	1,00	1,00	1,00	0,77	2,26	0,92	1,23	1,77	0,88	1,10	1,19
LUKAS Bank S A	0,45	0,94	1,27	1,07	1,08	1,08	0,40	1,71	0,95	1,04	1,00
Fortis Bank Polska	0,77	0,92	0,98	1,08	1,19	0,91	1,14	1,84	1,00	1,35	1,12
Invest - Bank SA	1,10	0,87	1,12	0,94	0,96	0,95	0,97	1,48	1,13	0,55	1,01
GETIN BANK SA	1,00	1,06	1,20	0,96	0,46	2,23	0,90	1,17	1,00	1,90	1,19
Średnia	1,03	0,93	1,01	0,99	1,14	1,10	1,14	1,19	1,06	1,16	1,08
Wartość maksymalna	1,65	1,17	1,27	1,08	2,26	2,23	1,45	1,84	2,08	1,90	1,19
Wartość minimalna	0,45	0,65	0,55	0,77	0,46	0,81	0,40	0,71	0,82	0,55	1,00
Średnie odchylenie	0,25	0,15	0,16	0,08	0,38	0,31	0,27	0,32	0,28	0,27	0,06

Source: Own calculation.

One can, therefore considered that the technical efficiency of banks in the second half of the study period was significantly higher. It should also be noted that the average Malmquist index value for all banks and the whole period is greater than 1 (values in last column). Similarly, the average values of the index Malmquist, except for the 1999–2000 period (the value of 0.93) for each year is greater than 1.

Table 4. Index Catch-up for IT efficiency

Catch-up	1989=>19	1999=>20	2000=>20	2001=>20	2002=>20	2003=>20	2004=>20	2005=>20	2006=>20	2007=>20	Średnia
PKO Bank Polski S.A.	0,76	1,13	0,95	0,90	1,89	0,69	0,81	0,68	0,69	1,42	0,99
Bank Polska Kasa Opieki S.A.	1,50	1,14	1,30	0,86	1,45	0,84	1,25	0,60	1,06	1,29	1,13
Bank BPH	1,00	0,37	1,32	0,79	1,76	0,74	1,01	1,95	1,00	1,00	1,10
ING Bank Śląsk S. A.	1,26	1,43	0,96	0,94	1,79	1,00	1,00	0,63	0,95	0,98	1,09
Bank Handlowy S.A.	0,75	1,38	1,26	0,84	1,22	0,57	1,56	0,48	0,87	0,71	0,97
Bank BGŻ	0,90	1,12	1,21	0,98	1,07	0,89	0,84	0,90	1,45	0,97	1,03
Raiffeisen Bank Polska SA	0,80	1,26	1,00	0,90	1,11	1,00	1,00	1,00	0,85	1,18	1,01
BRE Bank S.A.	1,00	0,67	1,27	1,11	0,81	0,58	1,20	0,79	1,08	1,25	0,98
Bank Zachodni BZWBK	0,82	1,23	0,89	1,21	1,32	0,76	1,09	0,93	0,98	1,15	1,04
Kredyt Bank	1,01	0,82	0,83	0,83	0,82	1,08	0,94	0,67	0,95	2,71	1,07
Bank Millennium	0,97	0,91	0,95	1,04	1,07	1,47	1,00	0,54	0,88	1,91	1,07
Bank Ochrony Środowiska	0,88	1,18	1,40	0,44	1,46	1,63	0,70	0,83	0,80	1,51	1,08
NORDEA Bank Polska	1,00	1,00	0,71	0,54	2,63	1,00	1,00	1,00	1,00	1,00	1,09
LUKAS Bank S A	0,24	2,13	1,08	1,15	1,28	0,81	0,27	2,37	0,69	1,50	1,15
Fortis Bank Polska	1,85	0,93	1,07	1,00	1,00	0,96	0,38	1,44	1,11	1,73	1,15
Invest - Bank SA	1,10	0,95	1,11	1,33	1,00	1,00	1,00	1,00	0,62	0,53	0,96
GETIN BANK SA	1,61	1,20	1,00	1,00	0,25	1,72	0,69	1,30	1,14	2,31	1,22
Średnia	1,03	1,11	1,08	0,93	1,29	0,98	0,93	1,01	0,95	1,36	1,07
Wartość maksymalna	1,85	2,13	1,40	1,33	2,63	1,72	1,56	2,37	1,45	2,71	1,22
Wartość minimalna	0,24	0,37	0,71	0,44	0,25	0,57	0,27	0,48	0,62	0,53	0,96
Średnie odchylenie	0,37	0,37	0,19	0,22	0,53	0,34	0,31	0,51	0,20	0,56	0,07

Source: Own calculation.

Table 5. Index Frontier-shift for IT efficiency

Frontier	1989=>19	1999=>20	2000=>20	2001=>20	2002=>20	2003=>20	2004=>20	2005=>20	2006=>20	2007=>20	Średnia
PKO Bank Polski S.A.	1,10	0,89	1,10	1,32	1,07	1,22	1,23	1,54	1,50	0,80	1,18
Bank Polska Kasa Opieki S.A.	1,21	0,97	1,04	1,36	0,86	1,51	1,07	1,79	1,34	0,84	1,20
Bank BPH	1,20	0,83	1,06	1,33	0,89	1,35	1,25	1,75	1,61	1,23	1,25
ING Bank Śląsk S. A.	1,13	0,84	0,95	1,32	0,67	0,94	1,89	0,92	0,90	1,30	1,08
Bank Handlowy S.A.	1,49	0,87	1,01	1,35	0,80	1,36	1,38	1,49	0,87	1,16	1,18
Bank BGŻ	1,12	0,91	1,06	1,29	0,76	1,32	1,81	1,08	0,91	1,30	1,16
Raiffeisen Bank Polska SA	1,31	0,89	0,98	1,29	1,02	1,44	1,42	1,48	1,12	1,17	1,21
BRE Bank S.A.	1,52	0,74	0,95	1,27	1,53	1,31	1,20	1,52	1,17	1,14	1,24
Bank Zachodni BZWBK	1,22	0,88	0,99	1,34	0,86	1,43	1,42	1,40	0,87	1,19	1,16
Kredyt Bank	1,38	0,84	0,96	1,28	1,23	1,22	1,68	1,54	1,45	1,18	1,28
Bank Millennium	1,21	0,85	1,07	1,26	0,96	1,51	1,27	1,53	1,42	1,08	1,22
Bank Ochrony Środowiska	1,24	0,86	0,95	1,90	0,82	0,92	1,45	1,41	1,34	0,84	1,17
NORDEA Bank Polska	0,94	0,75	0,89	1,48	1,29	1,32	1,48	1,23	1,00	1,13	1,15
LUKAS Bank S A	1,04	0,84	1,03	1,34	0,84	1,38	1,11	1,48	1,72	0,97	1,17
Fortis Bank Polska	1,48	0,84	0,93	1,33	1,07	0,89	1,98	1,05	0,80	1,85	1,22
Invest - Bank SA	1,03	0,78	0,84	1,87	1,09	1,34	1,64	1,37	0,87	1,00	1,18
GETIN BANK SA	1,19	0,91	1,17	1,79	0,50	1,18	1,17	1,11	0,81	1,62	1,14
Średnia	1,22	0,85	1,00	1,42	0,96	1,27	1,44	1,39	1,16	1,16	1,19
Wartość maksymalna	1,52	0,97	1,17	1,90	1,53	1,51	1,98	1,79	1,72	1,85	1,28
Wartość minimalna	0,94	0,74	0,84	1,26	0,50	0,89	1,07	0,92	0,80	0,80	1,08
Średnie odchylenie	0,17	0,06	0,08	0,21	0,25	0,19	0,28	0,24	0,31	0,27	0,05

Source: Own calculation.

Table 6. Malmquist index for IT efficiency

Malmquist	1989=>1999	1999=>2000	2000=>2001	2001=>2002	2002=>20(	2003=>20(	2004=>20(	2005=>20(	2006=>20(	2007=>20(	Średnia	Liczba lat efektywnych
PKO Bank Polski S.A.	0,83	1,01	1,05	1,19	2,02	0,84	0,99	1,04	1,04	1,13	1,12	7
Bank Polska Kasa Opieki S.A.	1,81	1,11	1,35	1,17	1,25	1,27	1,34	1,08	1,41	1,08	1,29	10
Bank BPH	1,20	0,31	1,40	1,06	1,57	1,00	1,26	3,42	1,61	1,23	1,41	10
ING Bank Śląsk S. A.	1,42	1,20	0,91	1,24	1,20	0,94	1,89	0,58	0,85	1,27	1,15	6
Bank Handlowy S.A.	1,12	1,20	1,28	1,14	0,98	0,78	2,15	0,72	0,76	0,83	1,09	5
Bank BGŻ	1,01	1,02	1,28	1,27	0,82	1,17	1,51	0,97	1,32	1,26	1,16	8
Raiffeisen Bank Polska SA	1,05	1,12	0,98	1,16	1,13	1,44	1,42	1,48	0,95	1,38	1,21	8
BRE Bank S.A.	1,52	0,50	1,21	1,42	1,24	0,76	1,44	1,20	1,26	1,43	1,20	8
Bank Zachodni BZWBK	1,01	1,09	0,88	1,61	1,14	1,09	1,55	1,30	0,86	1,37	1,19	8
Kredyt Bank	1,40	0,69	0,80	1,07	1,01	1,31	1,59	1,03	1,37	2,20	1,13	8
Bank Millennium	1,17	0,77	1,02	1,32	1,03	2,22	1,27	0,82	1,24	2,05	1,29	8
Bank Ochrony Środowiska	1,09	1,02	1,33	0,83	1,19	1,50	1,02	1,17	1,06	1,27	1,15	9
NORDEA Bank Polska	0,94	0,75	0,63	0,79	3,39	1,32	1,48	1,23	1,00	1,13	1,27	5
LUKAS Bank S A	0,25	1,79	1,11	1,55	1,08	1,11	0,30	3,50	1,18	1,46	1,33	8
Fortis Bank Polska	2,74	0,78	1,00	1,33	1,07	0,85	0,75	1,51	0,88	1,19	1,19	6
Invest - Bank SA	1,12	0,74	0,94	2,48	1,09	1,34	1,64	1,37	0,54	0,53	1,18	6
GETIN BANK SA	1,92	1,09	1,17	1,79	0,12	2,03	0,80	1,44	0,92	1,74	1,19	7
Średnia	1,27	0,95	1,08	1,32	1,25	1,23	1,32	1,40	1,08	1,62	1,25	7,5
Wartość maksymalna	2,74	1,79	1,40	2,48	3,39	2,22	2,15	3,50	1,61	3,74	1,50	
Wartość minimalna	0,25	0,31	0,63	0,79	0,12	0,76	0,30	0,58	0,54	0,53	1,09	
Średnie odchylenie	0,53	0,33	0,21	0,39	0,66	0,41	0,44	0,82	0,27	0,90	0,12	

Source: Own calculation.

Table 7. Malmquist index (IT and banks) – comparison

Indeks Malmquista	IT	Bank	Różnica=Bank-IT
PKO Bank Polski S.A.	1,115	1,029	-0,086
Bank Polska Kasa Opieki S.A.	1,288	1,035	-0,253
Bank BPH	1,407	1,169	-0,238
ING Bank Śląsk S. A.	1,149	1,058	-0,091
Bank Handlowy S.A.	1,095	1,033	-0,062
Bank BGŻ	1,164	1,044	-0,120
Raiffeisen Bank Polska SA	1,211	1,114	-0,097
BRE Bank S.A.	1,197	1,066	-0,131
Bank Zachodni BZWBK	1,189	1,025	-0,163
Kredyt Bank	1,133	1,061	-0,072
Bank Millennium	1,291	1,112	-0,180
Bank Ochrony Środowiska	1,148	1,056	-0,092
NORDEA Bank Polska	1,265	1,193	-0,072
LUKAS Bank S A	1,334	1,000	-0,334
Fortis Bank Polska	1,189	1,119	-0,070
Invest - Bank SA	1,180	1,006	-0,174
GETIN BANK SA	1,189	1,188	-0,001
Średnia	1,253	1,077	-0,176
Wartość Maksymalna	1,503	1,193	-0,310
Wartość Minimalna	1,095	1,000	-0,095
Średnie odchylenie	0,117	0,061	-0,055

Source: Own calculation.

Table 7 shows the comparison of values for Malmquist indexes for the bank's technical efficiency and effectiveness of spending on information technology. The correlation coefficient Malmquist indices for the bank's efficiency and effectiveness of spending on IT during the period is 0.55, a value of means an average linear relationship with both sets of test results. The analysis of data contained in the tables 6 i 7, you one can come to following conclusions:

1. Greatest difference in values for Malmquist index between the bank and IT efficiency occurs for a group of four banks (marked in grey in the table), the same time for those banks Malmquist index showing the efficiency of spending on IT is the largest in the group. For the rest of the banks from the group MI difference is less than 0.2.
2. The second largest variation of the Malmquist index between the bank and IT efficiency occurs for a group of four banks (marked in grey in the table), the

same time for those banks Malmquist index showing the efficiency of spending on IT is the largest in the group. For the rest of the banks from the group IM difference is less than 0.2.

3. All banks reached a mean value of M above unity. Average for IM for IT investment is 1.25 and is definitely greater than the average IM for efficiency of banks, which is 1.08.
4. Minimum value for both sets of averages is comparable and the values for IT -1,095 and bank 1.0 appropriate.
5. In study period only two banks have value of Malmquist index above 1. They are: Bank BPH and Bank PEKAO S.A. Poland. These banks have the highest average values of MI throughout the study and are respectively 1.41 and 1.29.
6. Largest group of banks are (seven banks), for which the value Malmquist index is greater than unity. A positive gain in efficiency was observed in 8 out of 10.
7. Average value for "effective years" for the observed population is 7.5, which means 75% efficiency in the period considered.

Conclusion

Proposed and described in this paper method of evaluating the efficiency of banks is one of many possible based on DEA. For testing the efficiency of the banks we deal with complex multi-dimensional evaluation of the company, which is the contemporary market. The test result indicates a constant and systematic increase in the efficiency of Polish banks and spending on information technology in the period considered. Based on the results it can be concluded increasing level of technical efficiency of banks in the period 1999–2008. The average value of Malmquist index was above unity and for the entire period was 1.08. Similarly, the average value of the Malmquist index – for the efficiency of spending on IT is above unity – 1.25. Pay attention to the seven banks that improved their efficiency of expenditure on IT in 8 of the 10 years studied. Measuring expenditure on IT using the Malmquist index indicates a growing level of investment in information technology in the Polish banking sector. It should be recalled that during this period the banking market in Poland was developing markets. Basic two currents change during this time accompanied by the banking business. During the period considered has been observed an intense process of consolidation of the sector and the parallel process of modernizing banking technologies, including the largest expenditures were observed in the area of information technology. Based on the obtained results and the measured values of Malmquist index may accept as true the two theses mentioned at the beginning of the study. In a study conducted, occurring high efficiency of banks in the area of IT spending is associated with a comparable technical efficiency of banks. The overall efficiency of banks in the second half of the period under review was significantly higher than that observed in the first half.

References

1. Annual Reports for Banks (2008–2009).
2. Annual Reports (1998–2008), 50 Biggest Banks in Poland, Bank.
3. Asmild M., Paradi J.C., Aggarwall V., Schaffnit C. (2004), *Combining DEA window analysis with the Malmquist Index approach in a study of the Canadian banking industry*, "Journal of Productivity Analysis", Vol. 21(1).
4. Beccalli E. (2007), *Does IT investments improve bank performance? Evidence from Europe*, "Journal of Banking and Finance", Vol. 31.
5. Berger A.N., Humphrey D.B. (1992), *Measurement and efficiency issues in commercial banking*, in: Z. Griliches (ed.), *Output Measurement in the Service Sectors*, Chicago.
6. Berger A., Mester L. (2003), *Inside the black box: What explains differences in the efficiencies of financial institutions?*, "Journal of Banking and Finance", Vol. 21.
7. Chen Y., Zhu J. (2004), *Measuring information technology's indirect impact on firm performance*, "Information Technology and Management", Vol. 5.
8. Cooper W.W., Seiford L.M., Tone K. (2007), *Data Envelopment Analysis. A Comprehensive Text with Models, Applications, References and DEA-Solver Software*, New York.
9. Cooper W.W., Seiford L.M., Zhu J. (2004), *Handbook on Data Envelopment Analysis*, Boston.
10. Cooper L.M., Seiford, Tone K. (2006), *Data Envelopment Analysis: A Comprehensive Text with Models*, Applications, References and DEA-Solver Software Second Edition.
11. Fare R., Grosskopf S. (1996), *Productivity and intermediate products: A frontier approach*, "Economics Letters", Vol. 50.
12. Fare R., Gross Kopf S., Weber W. (2010), *The effect of risk-based capital requirements on profit efficiency in banking*, "Applied Economics and Banking", Vol. 36(15).
13. Farrell M.J. (1957), *The Measurement of Productive Efficiency*, "The Journal of the Royal Statistical Society", Seria A, Vol. 120, No 3.

14. Farzipour R., Memariani A., Hosseinzadeh F. (2009), *Effects of coefficient correlation between inputs on the efficiency in data envelopment analysis*, "Modares Engineering Journal", Vol. 11.
15. Gospodarowicz M. (2000), *Procedury analizy i oceny bank*ów, NBR Departament Analiz i Badań, seria: „Materiały i Studia", Warszawa, Zeszyt nr 103.
16. Gospodarowicz A., Woźniewska G. (2002), *Problemy pomiaru wpływu technologii informatycznych na konkurencyjność banku*, „Bank", nr 10.
17. Grifell-Tatje E., Lovell C.A.K. (1995), *A note on the Malmquist productivity index*, "Economics Letters", Vol. 47.
18. Guzik B. (2009), *Podstawowe modele DEA w badaniu efektywności gospodarczej i społecznej*, WUE, Poznań.
19. Isik I., Hassan M.K. (2009*), Financial deregulation and total factor productivity change: an empirical study of Turkish commercial bank*, "Journal of Banking and Finance", Vol. 27(8).
20. Kopczewski T. (2000), *Efektywność technologiczna i kosztowa banków komercyjnych w Polsce w latach 1997–2000*, cz. I, Materiały i Studia NBP nr 113 , Warszawa.
21. Kubiak B. F., Sieradz A. (2013), *Efficiency Analysis of IT investment In Polish Banks (1998-2008): An Application of Malmquist Productivity Index*, "Journal of Management and Finance", Vol. 11, No. 3, Part 1.
22. Mukherjee K., Ray S.C., Miller S.M. (2007*), Productivity growth in large US commercial banks*, "Journal of Banking and Finance", Vol. 25(5).
23. Monitor IT ,DiS Nr. 20 ,(29.09.2008).
24. User User's Guide to DEA –Solver Pro, ver. 7.0.
25. Wang C. H., Gopal R., Zionts S. (1997), *Use of data envelopment analysis in assessing information technology impact on firm performance*, "Annals of Operations Research", Vol. 73, No. 1–4.

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