# INFORMATION MANAGEMENT IN PRACTICE


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# Table of Contents

# Preface

All chapters of this book have been focused on the most important aspects of modern Information Technologies trends. Those trend, widely discussed and described in this book, is the most important as a wide area of the innovation, mobility trends among customers and businesses, Big Data (or Deep Data) analysis or new concepts of cloud computing.

Most of the authors have been reflecting those trends in scientific and practical aspects of IT effectiveness, financial aspects of investing in new cyber economy, to minimize of cost and getting more flexibility out of it. Moreover, those were presented in the face of increasing pressure in effective development of IT solutions (Agile approach) we are faced those days in every industry. Even so, the importance of delivering the final results now so dramatically focus on time and "new versions" is always valid, but in many areas 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 aspects related to IT future solutions.

First group of subjects presented in the book is reflecting the business side of information management. Those are mainly in areas of business process modeling and redesign combined with the important issue of business model notation. Both are very important those days linked with observation of the market place where many businesses face an unquestionable need for rethinking and redesigning their business model. Another group of subject addresses a second most important business issues – operational excellence understood as a high level of automation in business processes and transactions. In today complex world, business processes have to be supported by business rules and automation standards implemented within automated business management systems. Authors presented this issues based on the IT projects or business cases there were involved in.

Second group of subjects are concentrated on minimizing the cost and affords of delivery IT solutions. In this area main current interest lays in scrum and agile IT delivery issues. Subject is not new in the face of long-lasting discussion between the practitioners and theorists about the advantage of classical waterfall approach against the quick and multistage approach around agile concept of IT development issues. This area is also linked to quality of data management in IT projects. Quality in delivering the final scope of IT projects is extremely important from dynamics of business development in modern business startups, and it is playing extremely important role in delivering on time and budget.

Functional security of IT platforms is another element of an organization overall security and depends on the correct operation of the integrated IT systems in response to fast moving inputs. The security platform is achieved through building in specialized security configurations into the integration platform. Next group of topics address the dynamic growth of IT architectures and integration layers from one side and fast growing of security issues in IT solutions. Those developed over the last several years have to comply with the new requirements related to systems architecture in terms of quality and functional security. Several aspects of security overlooked from corporate and administrative point of view has been addressed. Additionally during the conference security of documentation and management of lifecycle security systems and separately wide range of the issues related to systems architecture from the security point of view has been presented. Overall looks like, we are at the beginning of developing the methods for identifying and solving issues related to control IT systems, in order to maintain the required level of functional security.

Next papers represent group of the proposition related to "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 works are related to the most critical aspect of modern IT systems in every business, or administration – mobile solution integration with concept of cloud computing. Both concepts represent not only dynamically developing part of the IT market but at the same time moving the whole setup of IT service delivery in completely new dimension. The authors presented two remote concepts of using IT mobility concept. First is presenting of IT system for crowdfunding. The second is analyzing the websites for mobile operators.

The final subgroup of the works has been dedicated to the area of using the IT tools for intellectual property protection and knowledge transfer. This is a rising issues in times when number of innovation is growing very rapidly in any business area.

The aim of this book was to present new ideas and trends in modern Information Technologies. It could also serve act as a guidebook or inspiration for IT Management and decision makers in order to meet they own decisions. It also could be used for some of the 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, business managers, officials and investors. Presented work is the summary of conducted researches and donates innovative solutions which concern variety of industry and public sector.

It is a privilege of editors to thank all Authors involved in creating this book for their valuable contributions and insights. We would like to thank in particular our publisher Faculty of Management at University of Gdańsk, Poland. Special thanks go to Janusz Wielki, gave valuable contributions by his review, encouragement and close support during the writing of the book.

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Chapter 1

# The opportunities, impediments and challenges connected with the utilization of the cloud computing model by business organizations

*Janusz Wielki*

## Introduction

The results of numerous surveys clearly indicate the growing interest of organizations of varying types in IT solutions available using the cloud computing model. According to the report by Forrester Research, in 2020 the global public cloud market, alone will reach 191 billion USD. This is a significant correction of the previous 2011 forecast (160 billion USD) and almost two hundred percent growth from the end of 2013 (58 billion USD) [Gaudin, 2014]. The predictions by the analyst firm IDC are even more optimistic. According to their forecast, the global cloud market, including all types of clouds, will reach 118 billion USD in 2015 and 200 billion in 2020 [Gaudin, 2014a]. For Europe according to the European Commission, between 2014 and 2020 the use of publicly available cloud offerings is expected to achieve a 38% compound annual growth rate [EC, 2012, p. 16].

The dynamic growth of the cloud computing market is also confirmed by other data. IDC expects that in 2017 45% of all servers sold will be bought by cloud providers (in 2014 it was 25%–30%) [Thibodeau, 2013]. This estimate can be translated into predictions concerning global data center IP traffic. According to the forecasts of Cisco, the total global cloud data center IP traffic will grow at a compound annual growth rate of 36% from 2012 to 2017 and will increase from 1.2 zettabytes in 2012 to 5.3 zettabytes in 2017. At the same, the traditional data center IP traffic will grow at a compound annual growth rate of 12%, from 1.4 to 2.4 zettabytes. It means that in 2017 the global cloud data center IP traffic will be more than two times bigger than that in traditional data centers [Cisco, 2013, p. 4].

There is a growing number of various types and sizes of organizations which are interested in cloud-based solutions and in utilizing them. This fact is confirmed by the results of various studies. For example, a study conducted by Gartner between June and July 2012 surveyed 556 companies from nine countries and across multiple industries. According to the results of this survey, even at that time 19% of surveyed organizations were using cloud computing for most of their production computing, while 20% of them were using cloud-based storage systems for all or most of their storage requirements [Gartner, 2012].

Small and medium enterprises (SMEs) are also interested in the solutions offered by the cloud computing model. In 2013, Ipsos MORI conducted a survey, commissioned by Microsoft, among SMEs employing fewer than 25 people, from 22 European markets and Turkey. According to the results of the survey, 65% of respondents from Central and Eastern Europe confirmed usage of cloud-based services. In the case of respondents from Western Europe the cloud adoption rate was 45% [Boch-Andersen, 2013]. The results of a survey conducted a year later by Idea Bank and Tax Care among Polish one-man companies showed that 60% of those surveyed knew about and used various types of cloud-based solutions [Idea Bank, 2014].

Therefore, in this context of the growing interest in the cloud computing model, it is important to analyse a few of the key aspects connected with it. They include the following issues:

- the reasons for the rapid development of cloud computing;
- the opportunities and benefits which utilization of the cloud computing model brings;
- the most important problems and challenges faced by organizations when using the cloud computing model;
- the key issues connected with the implementation of a cloud-based approach.

An analysis of the above mentioned aspects is the basic goal of this paper.

## 1.1. The notion of cloud computing and the most important reasons for its development

As far as the cloud computing notion is concerned, the most frequently in this context one indicates various features characteristic for this model of information technology utilization [EC, 2012, p. 3–4]. The most commonly known and cited cloud computing definition was coined by the National Institute of Standards and Technology. According to it "cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" [Grance, Mell, 2011, p. 3].

The cloud computing model is connected with a completely different, from those so far used, approach to IT utilization by organizations. In this computing model, the World Wide Web is treated as a cloud of data, software and hardware and these elements can be "mixed" and used on-line [Wielki, 2012, p. 16–17]. In fact, it is the practical realization of the marketing slogan "Network is the Computer" coined in 1990 by Sun Microsystems. In such an approach the World Wide Web turns into the World Wide Computer [Carr, 2008, p. 113].

There are three basic service models which can be distinguished within the scope of the cloud computing model. The first (software-as-a-service – SaaS), with its roots in the 1990s, saw its popularity start to fall during the first few years of the new millennium [Rainie, Wellman, 2012, p. 94]. In this model, applications are hosted by a vendor and made available to customers on-line. vendor takes care of the continuity of function, provides security, is responsible for the application's development and adjusts the application's functionalities to the customers needs [Wielki, 2012, p. 120]. Examples of solutions belonging to this model are e-mail services (e.g. Gmail), software office suites (e.g. Google Docs or Google Apps), CRM software (e.g. Salesforce applications) or Big Data tools (e.g. Amazon Elastic MapReduce).

In the case of the second model (infrastructure-as-a-service – IaaS), a third-party vendor provides customers on-line access to a virtualized computing resource (storage, processing power, network infrastructure). The vendor is responsible for the maintenance of this resource and for ensuring it is efficient as well as reliable [Wielki, 2012, p. 120]. Examples of the solutions belonging to this model are such services as Amazon Web Services S3 (storage service), Amazon Web Services EC2 (resizable compute capacity) or Amazon Work Spaces (desktop computing service). A "subcategory" of this model was proposed in 2014 by Hewlett-Packard. It relates to services connected with access to data centers, which HP has termed facilities-as-a-service (Faas) [Thibodeau, 2014].

In the case of the third model, platform-as-a-service – PaaS, a cloud provider delivers a computing platform which allows application developers to create, develop, test and run their own applications [Wielki, 2012, p. 120–121]. Examples of such type of services are Google App Engine, Microsoft Azure, Force.com, BlueMix or BlueMix.

The above mentioned service models can be offered through four types of "clouds". As far as public clouds are concerned, a provider allows users open access to such resources as processing power, data storage, network infrastructure or usage of various types of on-line applications. There are two types of private cloud: internal and external. Internal private clouds are clouds which restrict access to their resources to employees of the host organization. External private clouds function off-premises but the applications run on dedicated servers and are protected by a service provider who provides secure access to the resources by means of a virtual private network. The third type of "cloud", community clouds, can be considered as a variant of a private cloud and their resources are available for the exclusive use of members of specific communities. They can belong to, be managed by, and operated by one or more of the organizations belonging to the community, a third party, or some combination of the two. The last type of "cloud" is hybrid clouds. These combine the infrastructures of two or more types of clouds (public, private, community). Remaining unique entities they are bound together by technology that enables portability of data and application [Grance, Mell, 2011, p. 3].

There are many reasons for the development of cloud computing model – based solutions. The most important include such issues as:
- growing bandwidth and reliability of networks (Internet links),
- development of Web services and their growing availability,
- processes for information technology commoditization.

## 1.2. Opportunities and benefits connected with cloud computing utilization

There are many diverse benefits and opportunities arising from the adoption of the cloud computing model. Although cost related issues are very often indicated as a key benefit [EC, 2011, p. 4; Olavsrud, 2013] in fact there are much more important advantages associated with this approach. According to the results of the 2014 Technology Innovation Survey, conducted by KPMG among almost 800 global technology industry leaders, there are four main categories of benefits connected with this technology. They include [KPMG, 2014, p. 15]:
- improved business efficiencies/productivity (37%),
- cost reductions (22%),
- faster innovation cycle (11%),
- accelerated time to market (10%).

Other reports also often indicate such as [Bisson et al., 2013, p. 63–64; Pratt, 2014]:
- increased agility,
- opportunities connected with the implementation of new business models,
- improved collaboration among business units and partners,
- geographic expansion,
- creating new opportunities for SMEs.

The benefits also include improving an organization's productivity, particularly in two key areas [Bisson et al., 2013, p. 65]:
- infrastructure and operating expenses,
- application development and packaged software.

According to estimates by the McKinsey Global Institute, in relation to the first of these, productivity gains will reach 20–30%. They result from [Bisson et al., 2013, p. 65]:

- reduced infrastructure and facilities footprint,
- high task standardization and automation.

In the second case the McKinsey Global Institute estimates that productivity gains will reach 10–15%. They result from [Bisson et al., 2013, p. 65]:

- standardization of application environment and packages,
- faster experimentation and testing.

There are many aspects of the cloud computing model which can result in lower costs. For example, if the physical IT infrastructure is considered the most important aspects include:

1. Reduction or elimination of waste related to the low level of hardware utilization.
2. Reduction of costs connected with hardware maintenance.
3. Lowering costs related to energy consumption.
4. Possibilities for the permanent analysis of costs and selection the optimal service level.

As far as the first aspect is concerned, when using a cloud-based solution, a company uses the resource level it currently needs and settles accounts on the per-use basis. Such an approach leads to the reduction or complete elimination of waste associated with the use of the physical IT infrastructure, such as computing capacity or storage systems. As the results of various surveys have shown, their utilization, in the case of the "traditional" computational model, is very often at extremely low level [Carr, 2005, p. 70; Bisson et al., 2013, p. 63].

The reduction of costs connected with the maintenance of the physical IT infrastructure of an organization is the next area of savings. It results from the fact that the service provider is responsible for the efficient and reliable functioning of the physical IT infrastructure. Utilizing a cloud-based solution results in a lowering demand for IT departments. As a result, some of the financial expenditures previously allocated for this purpose can be released. This fact is confirmed by the results of a survey conducted by Manchester Business School and Vanson Bourne between December 2012 and January 2013, of 1300 companies in the U.K. and the US which used cloud computing. In the case of 60% of respondents, this computing model has reduced the need for their IT team to maintain the physical infrastructure [Olavsrud, 2013].

The utilization of the cloud computing model can also be, especially in the case of large organizations, a source of significant savings in terms of energy consumption. It is estimated that by adopting cloud computing large American companies could annually save up to 12.3 billion USD in energy consumption [EC, 2012, p. 4].

Savings can also be made in the areas of monitoring, controlling and measuring which the cloud computing model, offers. This is due to the fact that client-organizations have access to automatic report systems which allow them to monitor the level of "consumption" of resources, along with the connected costs. This allows organisations the opportunity to actively manage and improve their cost structures, i.e. by changing their service-level agreement (SLA) to a less costly one, which translates into lower IT costs [Agarwal, 2014].

In the case of software utilization, the cloud computing model can lead to the reduction or elimination of costs connected with:

1. Purchase and installation of software, its maintenance and upgrade.
2. Purchase of wrongly selected software.
3. Low level of software usage.
4. Developing and testing of applications.

If the first aspect is considered, a company uses software which belongs to a service provider who makes it available on-line. Because of this fact, the provider not only incurs all costs connected with the software's creation, installation, maintenance, continuity of function and security, but also its development and for adapting the software's functionality to the user's needs.

The second area of savings connected with software relates to the purchase of the wrong software e.g. not meeting the requirements of end users or duplicating software the company already has. According to the results of a survey conducted by Sage (600 people from EU firms responsible for IT) this last aspect was the main reason for software spend waste in German enterprises [Sage, 2014].

With the third aspect, every organization which buys and installs software incurs costs associated with this, regardless of how much the software is used. If a company uses a cloud-based solution to base their "borrowing" and settling accounts on a "pay-as-you-go" model (also called a consumption model), significant savings can be made as companies only pay for the actual software used [Deeter, 2013, p. 7].

The last significant area of savings connected with the software-as-a-service model relates to the reduction of costs arising from developing and testing applications. This aspect is of particular importance in the case of organizations which build the software they need. By using applications delivered in the cloud model they offload such costs onto a provider.

There are many new factors connected with cloud computing which have an impact on faster innovation cycles. Easy and cheap access to tools for the development and testing of new products or services, e.g. cloud-based Big Data tools, is a good example in this context [Davenport, 2014, p. 163; Intel, 2014]. Big Data tools are already being used for this purpose by a growing number of companies [FedCSIS, 2013, p. 986].

Simultaneously, as was mentioned earlier, the implementation of cloud-based solutions leads to a diminishing demand for IT department employees responsible for the maintenance of an organization's' physical IT infrastructure and the release of some of the budget previously allocated for this purpose. This allows for the re-investment of the savings on innovative products or services. According to the results of the earlier cited survey conducted by the Manchester Business School and Vanson Bourne, this occurred in the case of 62% of the companies surveyed [Olavsrud, 2013].

Usage of the PaaS model is a good example as far as accelerated time to market is concerned. In this case companies which develop their own software instead of creating their own environment can instantaneously use ready-made tools for the application building process, delivered to them as a service.

If company agility, understood as the capacity of an organization to identify and capture opportunities more quickly than competitors [Sull, 2009], is considered, cloud computing significantly increases the possibilities of companies in this respect, due to the fact that utilization of the cloud-based model considerably broadens opportunities for the quick and flexible adjustment of an organization's IT infrastructure to new needs or new market situations. Such situations can require the implementation of new applications, adding new services or increasing computational capacity. In addition, using cloud-based solutions can be quicker than in the case of using a company's own staff [Bisson et al., 2013, 64].

Utilization of the cloud computing model also provides organizations with numerous new opportunities to implement new business models. In many cases, these business models would not be feasible without usage of this computational model. An innovative business model called *car sharing*, implemented by the Zipcar company is an example of such a situation. This business model is based on a complicated management system of a single set of cars which are shared by many users, which would not be possible without an advanced IT syste-m where one of the key elements is the utilization of the cloud computing model [Griffith, 2009; Kerpan, 2013].

Improved collaboration among business units and partners is made possible by the provision through the cloud of easily accessible, continually developing [Noyes, 2015], applications. This aspect combined with the above mentioned opportunities to build and implement new business models provides organizations with new possibilities for geographic expansion

The cloud computing model also provides small and medium enterprises (SMEs) with significant opportunities, especially in respect of costs. In the case of the smallest SMEs or start-ups with only small levels of capital at their disposal, this is not in relation to the reduction of costs previously incurred for IT infrastructure but rather opportunities to access hardware and software which would be not achievable in the traditional computational model, because of financial barriers, particularly around purchase of hard and software and the employment of skilled IT workers to cover maintenance. The cloud model and the associated possibilities of "hiring" services connected with physical IT infrastructure or applications, enables smaller firms to more effectively compete with large organizations [EC, 2012, p. 4]. They can also access sophisticated solutions such as the above mentioned Big Data tools or the programming environment in PaaS model. Just a decade ago the costs of accessing such computing power or data analytics tools would have been prohibitive not only for the smallest firms but for most SMEs. In the current market, they have a lot of easily accessible cloud solutions available at low cost at their disposal [Davenport, 2014, p. 163].

## 1.3. The most significant problems and challenges connected with the utilization of the cloud computing model

As is the case of all other IT solutions, those offered in the cloud model bring not only benefits and opportunities but also problems and challenges. According to the results of the above mentioned 2014 Technology Innovation Survey, there are three main groups of challenges connected with the cloud computing model. They include [KPMG, 2014, p. 15]:
- security (23%),
- technology complexity (16%),
- risk management (15%).

Security anxiety is undoubtedly the key concern connected with this technology, and is confirmed by the results of other studies [Vijayan, 2014; Bisson et al., 2014, p. 66]. According to the Cloud Security Alliance there are various types of security concerns including such aspects as: data loss/leakage; account, service, and traffic hijacking; shared technology vulnerabilities or insecure application programming interfaces [HP, 2012]. Of course the level of the potential risk depends on many factors, including the type of cloud being used, the service provider, the technologies being used (including data encryption) as well as the procedures it uses, or the procedures applied by a client-organization. In the latter case, it also relates to the phenomenon called shadow IT, which is employee usage of cloud-applications not approved by IT department for business purposes [Stratecast, 2013, p. 2].

The spread of the cloud computing model should also reduce the issue of technology complexity, due to the fact that service providers are likely to do everything to make their solutions as simple as possible and easily manageable. Such a trend is already perceivable. An example of such an approach is a management tool called AWS Config, offered by Amazon within Amazon Web Services. Its goal is to make the management of companies' cloud services easier. The significance of such tools will grow as enterprises increase the number of systems in the cloud [Ricknäs, 2015].

The third issue which causes the biggest anxiety among managers is risk management connected with the utilization of the cloud computing model. Apart from the above mentioned security-related issues, some of the most import challenges are those connected with the availability of services. The deeper the dependency of an organization on cloud-based solutions, the more important this issue is. In spite of numerous publicized cases of problems with the availability of cloud services from well known providers, availability of this type of service is generally at a very high level. This fact is confirmed by the results of various studies. In research conducted in France between 2007 and 2012 average availability was 99.917% [Gagnaire et al., 2012]. According to the results of AppNeta, a company monitoring market of cloud-based service providers, the average uptime of cloud services was 9.9948%, which means their average unavailability of 4.6 hours per year [Thibodeau, 2011]. Regardless of the level of availability of cloud services, every organization which utilizes the cloud computing model has to have appropriate procedures and technological solutions in place in case of problems with access to services. The same relates to the management of other types of risks.

Apart from the above mentioned issues, there are other challenges and limitations connected with the implementation and utilization of the cloud computing model. In the case of technical issues, one of the most important, and often underestimated issues, is network capacity [Gittlen, 2012]. This is due to the fact that cloud-based technology is deployed through massive data centres that necessitate high-capacity bandwidth [Bisson et al., 2013, p. 66]. Simultaneously bandwidth requirements can significantly differ depending, for example, on the type of cloud-based application (basic, intermediate or advanced) [Cisco, 2013, p. 14].

The next element can constitute a significant hurdle in the process of adoption of cloud computing approach, which is a reservation regarding the usage of the cloud-based model (lack of trust in cloud-based solutions). Such reservations are typically connected with issues such as concerns about placing sensitive data on third-party servers somewhere in the world. An important element of these concerns is the earlier mentioned issue relating to the reliability of cloud-based solutions. In spite of improvements in cloud technology, high-profile downtime accidents continue to take place. As a result, they affect public perceptions concerning the reliability of cloud-based solutions.

The next significant challenge which can constitute an important barrier to the implementation of cloud-based solutions are structural issues and cultural resistance in organizations' IT departments. It is connected with the fact that usage of such computation model causes deep changes in IT management practices and the functioning of IT departments. It can, and in many cases does, lead to raising concerns about loss of control and the lowering of significance and position of these departments in companies. The newly required skill sets are the next issue which can a source of fear and which can cause resistance. Another significant factor is connected with the complexity of migrating enterprise IT systems to the cloud [Bisson et al., 2013, p. 66].

There are also many legal challenges. They relate to such aspects as: regulations concerning the place of data storage and access to that data, data ownership, privacy and data protection issues, the applicability of the law connected with data protection or the scope of vendors' responsibility (including liability for data residing in a particular online location). These issues have yet to be settled by policy makers, and a significant barrier is the fact that the law in many countries does not address these issues. An important constraint in the ability to take advantage of some of the benefits of cloud-based solutions (especially those connected with public clouds) is fact that in many countries data protection laws restrict the possibility of storage and transfer of some types of data outside their borders [Bisson et al., 2013, p. 68; Van Eecke, 2013].

## 1.4. The most important elements connected with the cloud migration strategy

Although one could perceive the utilization of the cloud computing model as a relatively simple issue, in fact it is not true. There are numerous potential problems and challenges connected with its implementation and many aspects have to be carefully analysed and planned. It is obvious that implementation of cloud-based solutions is simplest in the case of companies without any previous "burdens" and legacy systems i.e. start-ups. But the bigger the company is, with many complicated business processes, the scale of the challenges significantly grows.

Generally the strategy connected with the utilization of cloud-based solutions and migration to this computation model should be based on three key phase:

1. Preliminary assessment phase.

2. Migration plan creation phase.
3. Implementation and maintenance phase.

In the preliminary assessment phase a management board, or especially established special committee, should make a preliminary assessment of the usefulness of utilization of the cloud computing model in the context of its impact on the organization's functioning. This relates to such issues as:

- assessment of whether the cloud computing approach aligns with the organization's culture e.g. in terms of outsourcing or not outsourcing any of own operations (a culture of risk avoidance [COSO, 2012, p. 10]),
- assessment of whether the cloud computing approach aligns with the organization's objectives and what would be the migration goals (improvement of productivity, cost reduction, increased agility, new business models implementation etc.),
- appraisal of the risk connected with the migration process in the context of the potential impact on it of internal and external factors,
- assessment of which key stakeholders would be impacted by the migration process and how,
- comprehensive assessment of the readiness of the organization to the migration process.

The last aspect is concerned with both technical and human issues. Technical issues relates to the cloud-readiness in terms of the requirements for broadband and mobile networks in the context of the organization's ability to use cloud-based services. In this case there are some characteristics connected with network access (Internet ubiquity) and network performance (download speed, upload speed, network latency) [Cisco, 2013, p. 15]. Human issues relates to the skills required from people such as vendor management or project management [Pivotal, 2015].

In the case of a positive assessment of the sense and advisability of usage of cloud-based solutions, it is then necessary to move to the second phase i.e. development of a migration plan. In its scope it is necessary to analyse more detailed issues (including technical, legal and organizational ones) and make final choices. It relates to such aspects as:

- determination of the final migration goals and choosing the business processes which should be cloud-supported,
- selection of the deployment model (cloud type) which will be used by the organization,
- selection of the delivery model(s) (SaaS, IaaS, PaaS) which will be applied and determination of the scope of their utilization (type of cloud-based applications, elements of the infrastructure which will be moved to the cloud etc.).

It is necessary to underline that choices concerning the deployment and delivery models have significant impact on the issues relating to the level of direct control of the organization o the solution and risk connected with it [COSO, 2012, p. 7].

Knowing the specific elements connected with the planned delivery and deployment model, the organization can then start the process of selection of a provider of cloud services. In this case it is necessary to determine the parameters (requirements) which should be fulfilled by the services delivered in the cloud mode and working out the metrics as precisely as possible (Key Performance Indicators), allowing for their control [Network, 2014; Oxford, 2014, p. 8]. It is also extremely important to determine requirements for such issues as: data security, back-up procedures, location of data, ownership of data or the scope of the provider's responsibility [Comcast, 2014, p. 8].

Other important issues which have to be planned include:

- the means of integration of the cloud-based solutions with the ones which will be functioning in the traditional way (legacy systems),
- determination of a disaster recovery plan and procedures including risk management program and incident management,
- organizational changes (especially in the IT department) i.e. their scope, their implementation and overcoming potential cultural resistance,
- necessary training and its scope,
- cloud governance model.

The third and final phase of the activities connected with the introduction of cloud-based solutions to an organization is the implementation phase, the maintenance and monitoring of their functioning in the context of performance of the organization as a whole. The key issues which have to realized in this phase include:

- final selection of the service provider and signing the contract including a Service Level Agreement (SLS),
- planning the dates of trainings and their execution,
- planning the date of the beginning of the migration process and its scope,
- testing the functioning of the implemented solutions and making required corrects,
- full realization of the planned migration,
- monitoring the functioning of the implemented cloud-based services based on a previously prepared cloud governance model.

## Conclusion

The dynamic development of solutions available in the cloud computing model and the growing interest in them has been noticed over recent years. They are perceived as one element of the next-generation IT infrastructure of contemporary organizations and as one of the disruptive technologies that will transform not only business life, but also the global economy [Gnanasambandam et al., 2014; Bisson et al., 2013, p. 4].

Undoubtedly, cloud-based solutions carry many opportunities. They relate to such issues as the reduction of IT-related costs, productivity improvements, a faster innovation cycle, increased agility or opportunities for the implementation of new business models. More and more organizations are noticing that without cloud-based solutions it would be more difficult to be able to store, analyse and use the rapidly increasing amounts of data critical for their market success and development [Acket et al., 2014].

But cloud computing also brings numerous potential challenges and concerns related to such issues as the reliability of cloud-based systems, data security, privacy or cloud-platforms compatibility. Also the migration process to cloud solutions includes many aspects which have to be well thought out and carefully planned. It relates to purely technical issues but also to organizational and legal ones. Lack of so called "best practices" which could be applied by organizations in their migration process is a real challenge [Pratt, 2015].

In the context of the above mentioned remarks, it is necessary to underline that an incorrect and ill-considered approach to the cloud computing phenomenon or just following some IT market trends can lead to a situation where instead of expected gains some problems will arise, negatively or destructively influencing an organization's functioning and achievement of its goals. Such a situation could arise because of the fact that cloud projects relate to a crucial component of every contemporary organization namely, the IT infrastructure which is the foundation of their functioning.

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Chapter 2
# Seven sins of e-government development in Poland. The experiences of UEPA Project

*Marcin Kraska*

## Introduction

We are on the eve of the new financial perspective for the period 2014–2020. There is foreseen $ 8 billion of EU funds (with the national contribution is more than 10 billion dollars) to support the development of Polish e-government [https://mac.gov.pl/polska-cyfrowa-po-pc, 2015], including among other things development of high-speed Internet, e-services and digital competence of Poles. In order to effectively spending these huge resources, it is important to look at the experience and conclusions from the implementation of the projects carried out in the previous period. Often, they constitute a rich source of information and guidance on what to fix, to change or which tools to make available, and in consequence which projects should be launched in the new financial perspective for 2014–2020. In the area of e-government one of these projects was "Simplification of procedures related to starting and running a business through their electronisation and implementation of the idea of the one-stop shop" (hereinafter referred to as UEPA Project), realized in 2009–2014 by the Ministry of Economy in a consortium with the Institute of Logistics and Warehousing and the Polish Chamber of Commerce. The work carried out in the Project, defined conclusions and proposals to solve, identified problems brought new light into the state of e-government in Poland and the vision of the direction of changes. The purpose of this article is to present the 7 major "sins" committed during the current e-government development in Poland, identified during the analysis of the UEPA Project. These are mainly sins of omission, which also contributed to the current state of development of e-government in Poland and still persisting long positions in the ranking of the United Nations on the computerization of state management processes. Poland was situated on 42$^{\text{nd}}$ place in 2014, albeit improved its position of 5 position in relation to previous studies from 2012. It is still far from the developed economies [http://forsal.pl/galerie, 2015].

## 2.1. About UEPA Project

As a result of the implementation of Directive 2006/123/ EC of the European Parliament and of the Council of 12 December 2006 on services in the internal market (Dz.U. L 376, 27.12.2006) (hereinafter referred to as the Service Directive) Poland, as well as other member state's countries are obliged to implement its provisions relating mainly to simplification and electronisation of the administrative procedures and creation of the Point of Single Contact (PSC). In order to comply with the provisions laid down in the Service Directive, Ministry of Economy established UEPA Project, in which the main objectives were:

- identification and preparation of descriptions of administrative procedures,
- preparation of templates of electronic documents, their publication in the Central Repository of Templates of Electronic Documents (CRWDE) and the preparation and implementation of e-services,
- simplification of administrative procedures,
- the establishment of a pilot version of the PSC,
- training of administrative staff and the employees of the courts in respect of the new procedures for business registration and operation of CEIDG,
- creating and maintaining Help Desk for users of PSC.

Realisation of the work under the project has brought many valuable results, which is a measurable contribution to the further development of e-government in Poland. The main of them are:

- 1179 administrative procedures have been identified in Polish legal acts,
- 75 selected legal acts and 103 public registries have been fully analysed,
- 645 description of administrative procedures, including a picture of the process running using BPMN, have been prepared,
- in the course of the project (2009–2014), due to the ongoing changes in the law and in consultation with the relevant ministries, descriptions of procedures were updated more than 1600 times.
- conclusions from the mapping processes were used to formulate the 527 proposals for simplification of administrative procedures which have been subjected to consultation with the competent authorities and the relevant ministries. The results of the work contributed to the amendment of certain acts, including, inter alia, the Act of 10$^{th}$ of January 2014 amending the act on computerization of entities performing public tasks and certain other acts (JL of 2014, item 183),
- 648 electronic forms used in 431 administrative procedures have been prepared,
- during the UEPA Project 158 templates of electronic documents were published in CRWDE being the basis for the implementation of e-services,

– throughout the country 510 competent authorities used e-forms based on the templates published in CRWDE. The part of implementations were made in the context of regional platforms. During the project 99 types of electronic services were implemented, including 22 e-services for ministries and 77 types of e-services for local government. The total number of implementations (type of procedure, x number of implementations) was 3311 and grew even after the completion of UEPA Project. It was one of the largest number of e-services implementation in projects financed from EU funds. Geographical location of service providers using e-forms prepared in UEPA Project is presented in Figure 2.1.
– applications developed in the project have been released to the public in the period I-VI 2014 have been downloaded 8965 times by service providers in whole country,
– 38 e-learning modules have been prepared designed to conduct e-learning courses to raise the knowledge and skills in the field of e-government among civil servants.

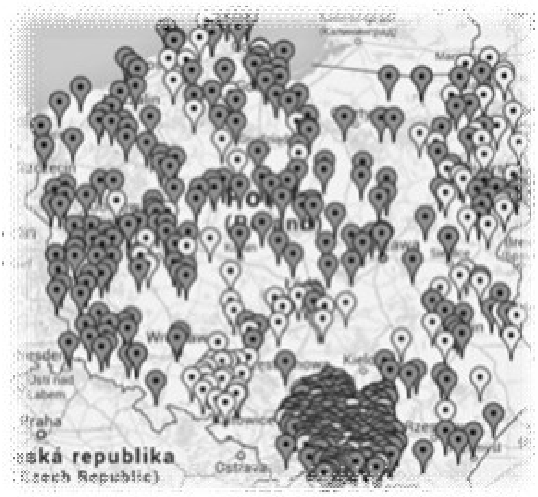



**Figure 2.1.** Geographical location of service providers using e-forms prepared in UEPA Project (June of 2014)

Source: [Kraska et al., 2014, p. 22].

## 2.2. 7 sins

A careful analysis of the law relating to more than 600 administrative procedures, direct interviews and consultations with the ministries, competent authorities and entrepreneurs, experience in electronisation of these procedures, as well as implementation of the PSC in Poland, have become an invaluable source of information on the state of development of e-government in Poland. Unfortunately, in most cases, they showed the face of the serious problems of e-government, rather than the positive image of its development. In order to present a more detailed conclusions from these experiments, the seven most important, "sins" of e-government have been selected from which we should be freed as soon as possible so as not to hamper its development in the future. These include:

1) lack of reference databases relating to the procedures, documents, public entities, and registries,
2) existence of legal barriers and lack of adjustment to the realities of e-government,
3) lack of standardization of documents,
4) decentralization of the registries,
5) duplication of work in different areas,
6) excess of the required data by service providers,
7) electronisation of paper.

### 2.2.1. Lack of reference databases

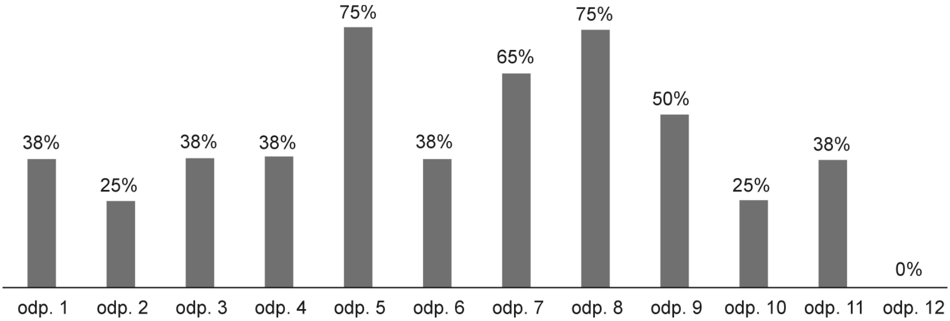
The experience gathered during UEPA Project shows that we operate in reality of great deal of ignorance about, that might seem, basic information necessary to develop e-government. Attempt to obtain reliable data on administrative procedures, records, official documents identified in the specific administrative procedures, or contact details of public bodies turned out to be a total failure. None of the bodies of state administration could answer the question of how many and what the administrative procedures were carried out and which documents were associated with these procedures. There was also impossible to obtain from any source complete and current contact database of public entities carrying out administrative procedures and database of public registries. Why is this knowledge so crucial in the development of e-government? To answer this question it must be emphasized that this is even an elementary knowledge in the development of e-government.

In the absence of identified administrative procedures, and in addition identified in a standard manner throughout the government, determine their type and validity, we operate in a situation of the chaos and the risk of losing its effectiveness. Firstly, it is not possible to build a strategy of e-procedures implementation and establish priorities. Secondly, there is no mechanisms to control activities and the risk of performing the same actions at different levels of administration. In addition, it is difficult to verify on which level of development in e-government our country is. Also, we are not able to state what administrative burdens lie on the side of citizens and entrepreneurs and effectively eliminate them. During the UEPA Project we managed to gain only the database of regulated professions, however, and this appeared to be out of date. Database of regulated professions, containing 380 items did not contain all the professions, which in Poland were covered by some form of rationing. This list did not include, among others, bailiff profession or the auditor. In addition, creating a database of administrative procedures for enterprises the problem of displacement and shifting supervisory responsibilities over a given procedure to another resort was encountered, despite the fact that this ministry was preparing guidelines for the act governing the procedure in question. It is desirable that there is knowledge in the state who and what procedures oversees and plays an executive role. This may have an impact on closer cooperation and exchange of information between ministries and executive competent authorities.

During building e-government systems it is also crucial to have a complete and constantly updated database of public entities. This database is a key source of data for users who want to obtain reliable data about what entity realizes a given administrative procedure. In the current situation, each system is based on its own internal database of public entities, updated themselves in a situation where there should be a single reference database of public entities. Although this database exists, because there is REGON, however, experience with the implementation of the PSC in Poland showed that its scope wasn't possible to use because of excessive generality of the stored data. In addition, the databases are incomplete and outdated, and does not provide a constant update of its contents. For example, the lack of complete data in the database TERYT did not allow to run the functionality in PSC to enable automatic transfer of the applicant to data of the local authority. This situation therefore raises serious problems, both arising from the unnecessary costs of maintaining many of the same bases as well as the lack of current data.

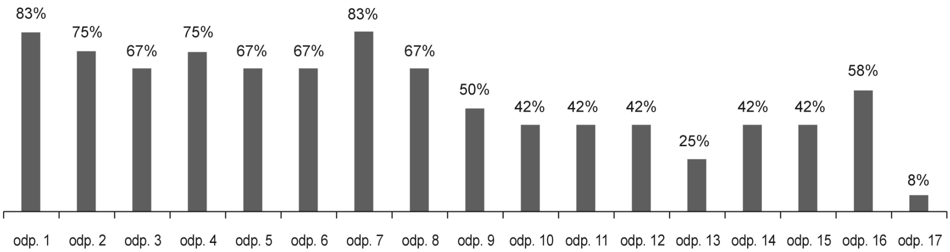
The documents defined in legal acts regulated specific procedures are the subject of electronisation. In spite of existence of CRWDE, the problem of access to document templates and link them with the administrative procedures is not solved. There is not also understandable that it was taken the decision of resignation in recent years of running the database of public registries. This is another area in which knowledge is currently limited. Again, they found the situation that it was not possible to obtain reliable data, this time on operating registries, their referral and ongoing relationships between them. Lack of control in this area raises many issues that have been widely described later in this article.

To sum up this area is worth to quote findings of research made in UEPA Project. It compiles together the existing with desired range of information. The results clearly confirm findings of the project and show that the data mentioned above are not collected (Figure 2.1). However, when the ministries were asked what range of information would be useful for the effective management of the organization of work, the ministries identified with strong support the need for the construction of databases mentioned above (Figure 2.2).




*odp. 1. The central list of all administrative procedures which ministry realizes*
*odp. 2. The central list of all administrative procedures, which are in the range of ministry and carried out by competent authorities*
*odp. 3. The central list of all templates of official documents issued by the ministry in legal act*
*odp. 4. The central list of all templates of electronic documents for which the ministry is responsible*
*odp. 5. The central list of all public registries that ministry leads*
*odp. 6. The central list of all public registries, which are in the range of departments managed by ministry and operated by local authorities*
*odp. 7. Data on the number of administrative procedures completed by the ministry in the year*
*odp. 8. Data on the number of electronic administrative procedures completed by ministry in the year*
*odp. 9. Data on the number of paper-based administrative procedures completed by ministry in the year*
*odp. 10. Data on the number of administrative procedures which are in the range of ministry, completed by the competent authorities in the year*
*odp. 11. Data on the average time of carried out administrative procedure, which are in the range of the ministry*
*odp. 12. Central list of problems collected from the competent authorities*

**Figure 2.2.** The scope of information available in the ministries
Source: [Kraska, 2014, p. 8].




*odp. 1. The central list of all administrative procedures, which are in the range of ministry*
*odp. 2. The central list of all the administrative procedures supervised by individual departments of the ministry*
*odp. 3. The central list of all administrative procedures which ministry realizes*
*odp. 4. The central list of all the administrative procedures implemented by the various departments of the ministry*
*odp. 5. The central list of all the administrative procedures which will change as a result of the modification of the legal act*
*odp. 6. The central list of all administrative procedures, grouped by government departments*
*odp. 7. The central list of all public registries that ministry leads*
*odp. 8. The central list of all public registries, which are in the range of government departments led by the ministry and operated by local authorities*
*odp. 9. The number of individual administrative procedures carried out in the selected period of time*
*odp. 10. The number of administrative procedures carried out by the chosen department in the ministry in selected period of time*
*odp. 11. Distribution of the number of individual administrative procedures carried out as a function of time*
*odp. 12. Distribution of the number of individual administrative procedures carried out in the country*
*odp. 13. Distribution of the number of individual administrative procedures depending on the form*
*odp. 14. The nationwide average duration of individual administrative procedures*
*odp. 15. The average duration of individual administrative procedures in local authorities*
*odp. 16 Central list of problems collected from the competent authorities*
*odp. 17 Others*

**Figure 2.3.** The scope of information that would be useful for the effective management of the organization of work in the ministry

Source: [Kraska, 2014, p. 9].

## 2.2.2. Legal barriers and inadequate provisions to the reality of e-government

One of the major problems in the development of e-government in Poland are legal barriers, which in many cases prevent from electronisation of procedures. During the analysis of the UEPA Project many words were identified as a not recommended from the perspective of e-government. It includes the following words: "paper", "in writing", "for inspection", "certified translation", "a certificate", "certified copy", "original", or even to determine how to define the frame document. These barriers clearly do not allow to take the process of electronisation.

The biggest problems are with the wording directly related to paper documents, as well as with the usage of the provisions of such words as: "for inspection" or "original". The word "for inspection" means that a citizen or entrepreneurs doesn't submit the documents electronically, because he is obliged to show physically a document for inspection. With the word "original" is a problem that government do not issue documents in electronic forms, so in any case talking about the original document means paper version of document, which can't be attached in e-services. The words "certified copy", "certified translation" also generate problems, since in practice nobody does such certificates in electronic version, so any procedure in which it is defined that certified copy or translation should be attached to the application form, it has to be made in traditional way. The following are examples drawn from the law, that contain not recommended words.

Example 1.
Procedure: Building permit
Legal act: Construction Law
Content: Four copies of the construction project should be added to application form (…).
"1. The construction project should be prepared in a readable graphic technique and bound in frame size A-4 (…)."

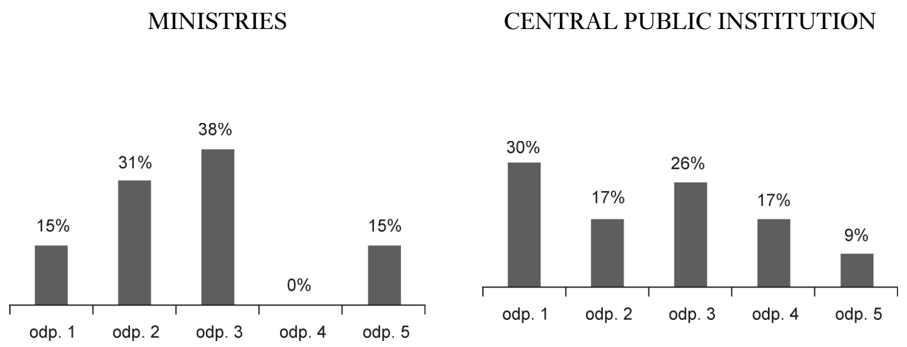
Example 2.
Procedure: registration into nurseries and children's clubs registery Legal act: Act of 4th of February 2011 about the care of children under the age of 3 (JL of 2011, No. 45, item. 235)
Content: In accordance with Article 28 Paragraph 2, the applicant is required to provide for inspection at the time of application for the registration of nurseries and children's clubs:

– a document confirming the legal title to the premises where care will be conducted,
– in the case of an individual, ID card or other document confirming the identity.

Example 3.
Procedure: The license for the lottery promotion device
Legal act: Act of 19th of November 2009. Gambling, JL of 2009, No. 201, item. 1540
Content: Art. 57. The documents attached to the applications should be submitted in the form of originals or copies certified by a notary or lawyer.

### 2.2.3. Lack of standardization of the documents

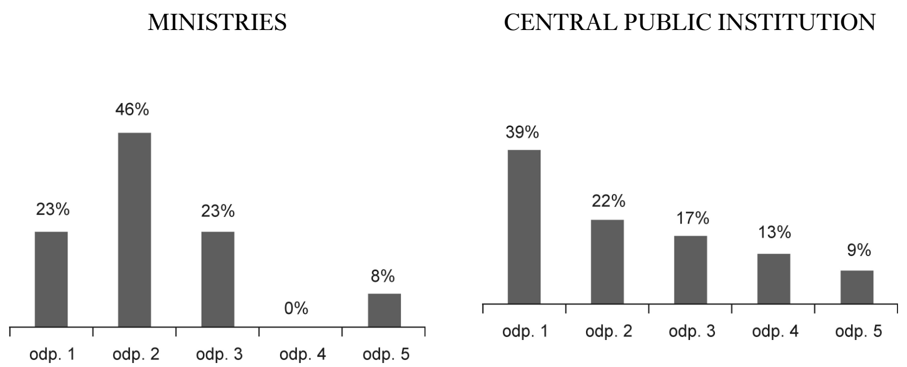
The electronic world likes standardization, because it is one of conditions conducive to the achievement of the efficiency of implemented solutions. Unfortunately, there is not ensured in Poland, in particular regarding official documents. In relation to few procedures you can meet the definition of an official document model in the legal act, which is also a model ready for electronisation. There is the comfortable situation in Poland that the law is uniform in most cases throughout the whole country. Once the templates of the document defined at the central level could be used by all competent authorities. However, reality is different. Every competent authority is forced at least to interpret the law, define the template of the document, to build the electronic document and published in CRWDE. In extreme cases it comes to the absurd situation that the same tasks are performed 2470 times (number of local authorities in Poland). In addition to the unnecessary costs another problem was also observed, namely the multitude of templates of official documents. In a situation where every competent authority makes their own interpretation of the law, and in many cases these interpretations are vague and official documents vary between them. Worse, in many cases also scope of required information differs. As a result, for example, an entrepreneur submitting the same documents in different municipalities, can meet the different requirements and it happens in a situation where the law is the same in whole country. Lack of standardized documents at the central level also has its consequences in situation where competent authorities do not define their own document templates, leaving interpretation for citizens or entrepreneurs. This causes a further problem for both the administration and applicants. It creates additional work resulting from the need to examine whether document prepared by the applicant is correct and contains all the information required by law. In order to submit the appropriate documentation to the competent authority applicants have to carefully analyse and interpret the law, and any errors at this stage could affect the extension of the procedure. Therefore it was postulated a situation where official standard models of official documents should be defined for each case, what significantly facilitated the implementation of official matters and contributed to achieving significant cost savings. According to the study carried out in the UEPA Project it is the desired state. Most ministries and central authorities positively answered a question about the obligation of preparation both official paper and electronic version of documents for every administrative procedure (Figure 2.3 and 2.4).




*odp. 1. YES. odp. 2. Yes, but with some exceptions odp. 3. Rather Yes. odp. 4. Rather NOT odp. 5. NO*

**Figure 2.4.** The level of support obligation to prepare the paper version of template of documents for all administrative procedures

Source: [Kraska, 2014, p. 38].




*odp. 1. YES. odp. 2. Yes, but with some exceptions odp. 3. Rather Yes. odp. 4. Rather NOT odp. 5. NO*

**Figure 2.5.** The level of support obligation to prepare the electronic version of template of documents for all administrative procedures

Source: [Kraska, 2014, p. 39].

## 2.2.4. Decentralization of the registries

The state of development of public registries is another serious problem noticed in UEPA Project what influences the development of e-government in Poland. In the course of the analysis of more than 100 registries, the following main problems have been identified associated with their functioning:

- no standard of the way of keeping data in registries – in effect there are word or excel files or dedicated systems,
- the necessity of undertaking multiple updates of the same data in multiple registries (data redundancy) – when the entrepreneur runs a business in different locations and the type of activity requires the registration in different registries, in a situation of changes in the contact data he is obliged to make these changes not in the specific entrepreneurs' registry, but to notify changes in a disciplinary registries in different regions. Worse, in many cases, entrepreneurs don't do it, what leads to a dangerous situation that the data are outdated in registries.
- lack of communication between local registries – due to the fact that there is no exchange mechanism of the data between registries, it isn't able to react in a situation where, for example, the entrepreneur obtains the prohibition of the activity in one region, and the same evidence exists in another region but was not detected,
- lack of cohesion of data in registries – usually as a result of negligence and not respecting the rules the entrepreneurs do not actualize the data in registries. In consequence the data in registries are inconsistent,
- performing unnecessary activities by various levels of government – this situation occurs in particular when there is obligation to transfer data from local registries to regional registries. No electronisation of registries leads to a situation where authorities perform the same operations, e.g. the storage or archiving the same data,
- too high costs to run and maintain registries.

### 2.2.5. Duplication of work

The problem of duplication of work has already been addressed in the standardization, but it also occurs in other areas. A similar situation as in the case of documents is observed also in case of descriptions of procedures published on websites of competent authorities or regional e-government platform. There is not a rational justification for a multitude of descriptions of the same procedures. In addition, it makes no sense to build regional platforms in every region that functionalities do not differ, especially as central platform ePUAP exists.

### 2.2.6. Excess data requested by competent authorities

During the consultation of e-documents with competent authorities, it have been revealed differences in the interpretation of the law. Moreover in the confrontation of procedure description with ministry which prepared regulations governing this procedure, it was found that there was a misinterpretation of the law and consequently entrepreneur needed to provide a wider range of data than was apparent from regulations. In addition, it was noted that competent authorities didn't respect Article 220 of the Code of Administrative Procedure, under which „a public authority may not require the certificate or statement to confirm facts or legal status if

1) it is known to the competent authority ex oficio.
2) the competent authority is able to determine on the basis of:
   a) owned registries or other data,
   b) public registries of other public entities to whom authority has access by electronic means under the terms of the Act of 17th of February 2005 on computerization of entities performing public tasks,
   c) the exchange of information with other public entity under the terms of the provisions on computerization of entities performing public tasks,
   d) presented by the person public documents for inspection (identity card, proof of registration and other)".

Despite the clear record, competent authorities still require documents that confirm the information that can be easily checked even in the registries accessible via the Internet. For example, it is common practice to request for providing an extract from the registery. Worse still, in many procedures, law regulates that obligation. Below one of the examples is presented. It is curious that at the European level Polish authorities exchange data via IMI system, but there is no practice of close cooperation between authorities in Poland.

Example 4.

Procedure: Permit for operating a pharmaceutical wholesale (veterinary products)

Legal act: Act of 6th of September 2001 Pharmaceutical Law (JL of 2008., No. 45, item 27)

Content: Art. 75. 1. An application for a permit to operate a pharmaceutical wholesale, hereinafter referred to as "the application" should contain:

1) designation of the entrepreneur applying for a permit;

2) (...)

2. The application should be accompanied by:

1) an extract from the registries in accordance with separate regulations;

2) (...)

### 2.2.7. Electronisation of the paper

The analysis of official documents revealed another problem, namely, the direct mapping of official documents in the context of electronic documents. This practice leads to absurd situations that electronic document has space for a signature or stamp. Now there is practice to use wizards due to the ability to provide a much friendlier form of filling the data. They direct the applicant step by step in the document, without requiring the applicant to fulfil the same data in the case where it should be provided in several places of the document. In addition, thanks to the wizards it is possible to present a document in a more friendly form than in the case of an official document.

## Conclusion

There are many "sins" committed in the development of Polish e-government. This article seeks to identify the most important ones, which were observed during the realization of UEPA Project. Worth to emphasize is the fact that they do not remain only on the identification stage. The descriptions of specific solutions are the result of further work, both based on the concept of system solutions, or changes in the law relating to specific procedures. In the context of these problems, two documents are worth to mention:

- Document of Simplification Proposal No. 26 containing proposals for simplification of administrative procedures by the construction of the Central Electronic Catalogue of Administration, which includes a proposal to solve the problem of lack of basic databases, including entities, documents and registries databases,
- Document of Simplification Proposal No. 29, including a proposal for the construction of the Central System of Registries, which is a response to the disorder in the public registries.

The new proposal for the new financial perspective for 2014–2020 has been launched, so it is high time to make an examination of conscience for the Polish e-government and to solve problems, not to hamper its further development.

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Chapter 3
# Analysis of the use of mobile operators' websites in Poland

*Witold Chmielarz, Konrad Łuczak*

## Introduction

The main aim of the research is to analyse the websites of internet mobile operators. The analysis was carried out from the point of view of mobile devices users and their awareness concerning the possibility of managing access to mobile networks, the environment where it takes place and services offered to individual clients. The subject of the study concerns, on the one hand, various types of mobile devices and applications available in the mobile space; on the other, the evaluation of the quality of services offered by operators on the websites.

Polish mobile market, which is dominated by a few key players, is still developing. At present, however, it starts to shows signs of saturation. The new phenomena which drive its dynamics are primarily: the development of mobile technologies connected with miniaturization and the increasing processing power of the equipment[1] (in particular: smartphones, phablets[2], tablets), the development of mobile applications (mainly running on three operating systems: Android, iOS, Windows) and interoperability (generally manifesting itself with increasing cooperation with financial institutions).

After three quarters of 2014 the number of clients of mobile operators in Poland (subscribers and users of pre-paid services) amounted to 57.3 million. The study indicated there were 1.49 subscribers per one inhabitant. In the first three quarters of 2014 the number of subscribers and users increased by 0.7 million, as compared with the increase of 1.7 million in the same period last year [http://www.telix…, 2015].

As far as customer base is concerned, the mobile market is divided between four largest operators: T-Mobile – 28.92%; Orange – 28.67%, P4 (Play) – 21.68% and Polkomtel (Plus) – 19.31%. This roughly even division is supplemented with

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1 Gordon Moore proved empirically that the optimal number of transistors on an integrated circuit increases in subsequent years in accordance with the exponential trend. Currently, it is assumed that the number of transistors in the microprocessor for many years doubles approx. every 24 months [http://svmoore…, 2015].

2 Phablet, combination of words: "phone" and "tablet", is the term relating to mobile devices equipped with a touchscreen with the diagonal exceeding 5 inches.

a small share of virtual operators amounting to 1.42%. The first position in the market is taken by T-Mobile which represents the base of 15.728 million clients; Orange recorded a slightly smaller number of users, and the last position in the ranking was taken by Polkomtel (Plus) with 10.5 million clients.

The structure of the value of sales revenue in the mobile operators market differs slightly from the above analysis. The total value of the market at the end of 2014 reached 45.32 billion zlotys, and particular operators held the following shares: Polkomtel (Plus) – 30.2%, Orange – 29.3%, T-Mobile – 24.5% P4 (Play) – 15.5%. The market share of other operators was at the level of 0.4% [http://www.google…, 2015]. The structure of the market value is directly proportional to the combination of the relation of subscribers to the pre-paid users and to the total number of clients. The mobile operators with the greatest number of subscribers are Polkomtel (Plus) – 63%, and Orange – 48%.

The difference in the positions of P4 (Play) and T-Mobile in the presented ranking results from the greater total number of users of T-Mobile (3.9 million more users) and lower average value of services of P4 (Play). Other important factors which impact the general lower value of the market are international external conditionings – among others, Polish membership in the European Union.

The fastest, over 3% increase was recorded by P4 (Play), and the largest decline was indicated in the case of T-Mobile clients – 2%. CSO (GUS) data show that about 54% of the clients were pre-paid card users, and the remaining 46% were subscribers of mobile services [http://inwestor…, 2015].

One needs to bear in mind that the market of mobile operators constitutes the first link of the extensive chain of telecommunication services providing connectivity between particular market participants. Next links and components are companies producing and supplying this market with communication devices such as telephones, smartphones, phablets, tablets, personal and desktop computers, etc.

Other essential elements are websites providing software: desktop and mobile applications. As far as operating systems and mobile apps are concerned, we may note that Android strengthens its dominance in the global smartphone market with over 255 million units produced, which represents nearly 85% of the market. The market share of the second operating system, iOS, in Q2 2014 decreased from 13% to 11.7%, as compared to Q2 2013. The significant reasons for the weakening position of iOS are among others: the closed nature of the system (e.g. no memory cards, Adobe Flash technology or support for third-party software, limitations of some data transfer functions) and the price of final products provided by Apple. With the rapid growth of smartphone users in highly populated and developing countries of Asia and South America, the price factor plays a decisive role, and it directly translates into the reduction of the share of iOS in the global market. It should be emphasized that, although the sale of Apple products is growing [http://apple…, 2015], it still does not maintain the pace which would allow the company to keep its over 20% share in the market which was recorded three years ago.

Over the past year we could note the following trends in the market of mobile operators:

– decrease in the value of the market (in 2013 by 2 billion zlotys (a roughly similar decline in value was recorded in 2014)),
– the development of mobile applications for smartphones, phablets and tablets,
– the development of the mobile Internet market (LTE – fast, mobile data transfer),
– cooperation with the banking sector (e.g. T-Mobile – Alior Bank; Polkomtel (Plus) – Plus (Invest) Bank; Orange – mBank).

Under the circumstances of the more and more balanced market divided between the four market operators offering similar prices, competing with new services and quality appears to be the best strategy. As we may note, the visible, growing tendency to purchase smartphones and tablets results in a greater number of clients and greater importance of the quality of websites. In the second quarter of 2014 the market of smartphones increased by 25% per year, as compared to the second quarter of 2013, and the number of units produced reached 335 million units [http://idc…, 2015].

Websites of mobile operators and the range of functionalities which expands on a monthly basis may be seen as manifestations of competitive activities which focus on improving service quality. Taking into consideration the scale of the phenomena: over 67% (25.7 million, out of 38.5 million people) are Internet users; 15.9 million of active mobile Internet users in Poland constitute 41% of the entire Polish population [http://wearesocial…, 2015]; the time spent surfing the Internet every day is 4 hours 51 minutes for users of tablets and PCs and 1hour 49 minutes for smartphones users, the question appears whether the users of mobile devices and mobile networks are aware of the existence and the usefulness of websites and the available services. This analysis and obtained findings may provide answers to these questions.

## 3.1. The assumptions of research methodology

The fact that there are still few relevant publications concerning the area of the development of mobile services[3] the authors have undertaken an in-depth study consisting of the following stages:
- analysis of a selected group of smartphone users, concerning the characteristics of the time and usage of the devices as well as the users' opinions on mobile applications run on them and their sources,
- establishing, on the basis of survey responses, the most significant criteria in the evaluation of websites distributing mobile applications; their expansion into sub-criteria, and subsequent comparative analysis of websites offering mobile applications,
- comparative analysis of websites of mobile operators as providers of communication services and a packet of additional services connected or not (i.e. complementary) with the management of an individual service account opened with a particular mobile operator.

The first two stages of the research were presented in previous publications [Chmielarz, 2015a; Chmielarz, 2015b]. In the presented publication the authors concentrated on the first part of the third stage of research, which is a general analysis of the use of mobile operators' websites. The test procedure was similar to previous stages:
- selection and justification of the study sample,
- creation of a survey concerning the evaluation of the use of mobile operators' websites,
- application of a standardized scoring method for comparative analysis,
- analysis and discussion of the findings and the implications of the study.

In the study the authors analysed the websites of four largest mobile operators: T-Mobile, Orange, Polkomtel (Plus) and P4 (Play), which play dominating roles in the market and cover, as the author previously indicated, 98% of the market.

The survey was distributed only in the electronic form (through the servers of the Faculty of Management in the University of Warsaw) at the beginning of January 2015. The selection of respondents was dictated by convenience and it was the case of purposive, random sampling. Since the main socio-demographic features which differentiate the scope of usage of telecommunication services are: age, income and education [http://www.uke…, 2015c], the authors selected the group which is believed to use the Internet and mobile access most frequently. The sample consists of university students, i.e. young, well-educated people who are willing to spend more money on technological innovation than other social

[3] The literature relevant to the subject consists mainly of statistical reports, e.g.: [http://www.uke.gov.pl/files/?id_plik=16757; http://www.uke.gov.pl/files/?id_plik=14746].

groups, despite their relatively lower income. Interestingly, the case of landline telephony shows the inverse relation, as the group which most frequently uses the landline phones are elderly people (over 60 years of age), with primary or vocational education, living in the rural areas, in households consisting of many people (5 or more people).

The groups of respondents analysed in this study were students of randomly selected groups of two universities: the University of Warsaw and Vistula University (Akademia Finansów i Biznesu Vistula) from various systems of study – mainly BA, BSc and MA studies. It should be noted that a similar choice was made in the case of previous research.

The survey was filled in by 292 people (262 of interviewees completed the questionnaires correctly), only for the websites of mobile operators they were familiar with. Among the respondents the share of women was 65.55%, and 34.35% of survey participants were men.

The largest number of respondents used Samsung devices – 30.48%, 28.77% used Apple products, 14.04% – Sony, 9.59% – LG, and 4.79% of respondents used HTC. The shares of other producers, in total, were at the level of 12.33%, and the share of particular brands did not exceed 1%. Over 68% of respondents use mobile devices for private purposes, over 26% for professional purposes, and 4.96% of interviewees have two telephone numbers and they use their devices for both private and business purposes.

Over 46% of respondents have used their mobile devices for over 5 years, 14.50% – from three to five years, 12.21% for two or three years, 15.65% for a year or two years, and 11.45% for less than a year. Over 60% of respondents have used mobile devices for more than three years.

The greatest number of people – over 95% were from the age group of 18–25 years, typical for students of BA and BSc studies, mainly with secondary education (90%), and 4.2% of interviewees from the age group of 26–35 years, characteristic of students of full-time MA studies and part-time BA studies. Less than 1% of respondents represented other age groups. 90% of interviewees declared having secondary education, 7.6% represented groups with BA or BSc education, and 2.29% of respondents represented the group with higher, II cycle education.

Over 43% of survey participants declared coming from the city of 500 000 residents, nearly 17% from towns with 100–500 000 inhabitants, over 18% from towns with 10–100 000 inhabitants, nearly 8% from towns with up to 10 000 inhabitants, and 14.5% of respondents were from rural areas.

The greatest number of survey participants – 41.6% used the services of P4 (Play), the second position was taken by Orange (27.86%), followed by T-Mobile (22.52%). The last position was taken by Polkomtel (Plus) – 15.3%. The share of virtual operators is just 3.44%, but it is still growing (Figure 3.1). The result appears to be distant from the analyses presented in the earlier parts of material concerning the national averages.

Over 70% of respondents either never changed their operator or they did it only once. Only slightly less than 7% changed the mobile operator three times. None of respondents admitted changing the operator several times. Over 83% of interviewees pay relatively little for telecommunications services – up to 100 zlotys, less than 1% over 300 zlotys per month.

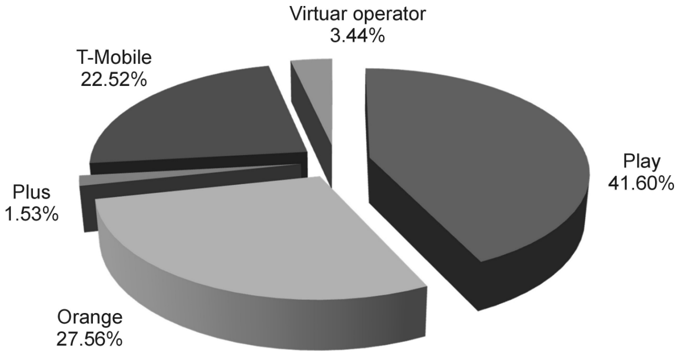


**Figure 3.1.** The structure of mobile operators in the analysed group of respondents
Source: Own elaboration.

In terms of standard services, most frequently mobile devices are used for telephone calls and sending short text messages (about 30% each) and taking photographs or recording short films (21%). Non-standard functions (previously performed on a personal computer) are used in the following proportions (in this case one person could give more than one answer): searching the information in the Internet – 90.7%, using social networking – 90.3%, playing music – 72.5%, sending and answering emails – 63.1%, mobile banking – 44.9%, online shopping – 17%, and listening to the radio – 12.7% (Figure 3.2). This indicates the convergence of the use of mobile devices to the use of desktop and personal computers. Simultaneously, almost 88% of users of mobile devices believe that they have the necessary skills to use information technology at a medium or high level, and more than 6% consider themselves to be professionals in this field.

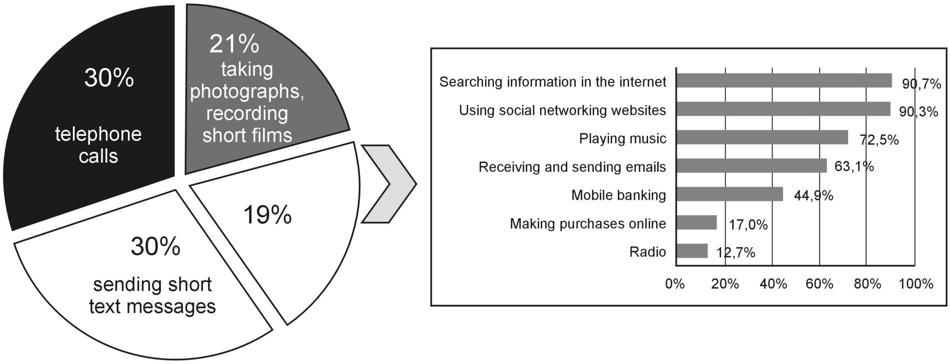


**Figure 3.2.** The application of mobile devices in the analysed group of respondents
Source: Own elaboration.

## 3.2. The analysis of the obtaining findings

As far as the frequency of use of mobile operators' websites is concerned, the most frequently obtained response was the answer: "I use them rarely" (61.45%). The next, frequent response given by the survey participants was "I never use them" (18.70%). However, the remaining share of 19.85% respondents who use these kinds of services most frequently could provide exhaustive answers to the questions included in the questionnaire. The part of the survey which concerned websites of mobile operators consisted of evaluation and postulates. In the evaluation the authors address the issue of the range of functionalities, graphic design and usefulness of the website. The full list of criteria and sub-criteria, based on them, is presented below:
- checking the balance, payments and invoices,
- telecommunications service contracts,
- making payments,
- customer account management,
- making purchases,
- checking special deals offered by the operator,
- using entertainment services on the website,
- using banking services provided by the website,
- contact with Customer Service (BOK),
- effective and efficient service delivery,
- clear presentation of tariffs (correct presentation of the offer),
- functionality (the quantity and quality of the available functions, the ease of movement and finding functions, ease of use),
- user-friendliness (ease of navigation, intuitiveness, ease of finding answers),

– visualization (color scheme, lettering, background, graphic design),
– search functions (ease and availability),
– lack of technical problems.

The authors have used a simple scoring method to analyse the collected data. They applied a simplified, standardized R. Likert's [Likert, 1932, p. 1–55] scoring scale for the evaluation of every distinguished criterion. According to this scale each criterion has been evaluated in the following way:

– 0.00 – criterion is not being realized, the highest costs in economic criteria,
– 0.25 – criterion is realized at a minimum, sufficient level,
– 0.50 – criterion is realized at the medium level,
– 0.75 – the level of criterion realization is good,
– 1.00 – full realization of criterion, the lowest costs in economic criteria.

Each of the respondents evaluated individual criteria subjectively. The ratings were added up; subsequently, the author has structured them and performed their absolute and comparative evaluation. The scoring method is being criticized for the subjectivity of its evaluations, but, simultaneously, it is believed that the wide reach of the study and the compilations and averaging of scores allow for greater objectivity of the assessments. The simplicity of the assessments results in the fact that respondents make relatively few mistakes and they are more willing to participate in the surveys than in the case of questionnaires and surveys conducted with the application of other methods. Also, the obtained results are relatively easy to interpret. Based on the author's experience, we may note that in the case of comparative analysis of websites, the results obtained by means of this method are in no way inferior in relation to the findings recorded with other, more sophisticated methods (AHP/ANP, Electre, Promethee and others) [Chmielarz et al., 2011].

The first part of the analysis consisted in identifying and specifying the factors which are of greatest importance for the users of telecommunication operators. The averaged (in relation to the entire operators' market) scores for particular factors are presented in Figure 3.3.

Visualization (62.88%), technical issues of user-friendliness, functionality, correctness and the proper presentation of the offer (clear presentation of tariffs) appeared in the first place among all the evaluation criteria.

From the users' point of view the remaining criteria are fulfilled by websites in less than 50%. The lower scores were assigned for services which perform the functions which are seen as complementary in relation to the standard packet of telecommunication services. Surprisingly, little interest is drawn by services providing entertainment, banking services or online shopping. Among the few visitors, mobile operators' websites gained little recognition. Websites of mobile operators, if they are known at all, are associated rather with services closely related to administering the user account, in particular with making payments and determining the scope of services provided by the operator for the client.

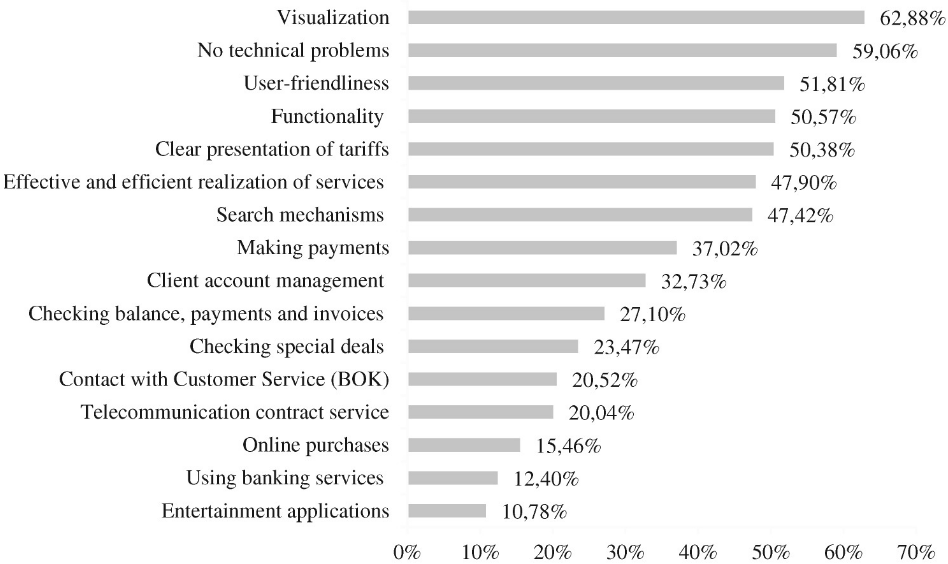


**Figure 3.3.** The averaged evaluations of criteria of the quality of telecommunication operators' websites

Source: Own elaboration.

One may be under the impression that operators are not interested in the dissemination of information about the functionalities of their websites and they are not interested in promoting this channel of communication with clients. It may also concern the use of websites offering products and services under the operator's own brand (e.g. financial services, television, electric energy sales), which could play educational and cognitive role as well as the one connected with creating value [https://bankinghub…, 2015]. The websites are designed in a rather unclear way, the manner of realizing services is seen as inefficient and complicated: the presentation of offers is complex and unclear, which is seen by a customer as misleading rather than helpful in making the correct choice with regard to selecting the offer which would be best for him. The opinions of the telecommunication service users expressed in online forums are frequently negative [http://forum-play…, 2015; http://spiderweb..., 2015; http://opiniuj..., 2015]. Perhaps the situation might change, at least to a certain extent, if users were more familiar with the functionalities of websites of mobile operators. The operators, however, do not seem to aim at reaching such objectives – they appear to create websites in order to keep up with their competitors and possibly "channel" and control discussions about them.

This is probably the reason for the low opinion of customers on the websites of mobile operators. In the evaluation of other websites the low scores for visualization (here: 62.88%), user-friendliness and functionalities (slightly over 50%) are relatively rare phenomena. The average evaluation of particular selected criteria in this case amounted to 35.60%, which taking into consideration the characteristics of respondents interviewed in the survey (young people (95% at the age of 18–25, and 4.2% in the group of 26–35 years of age) who declared having at least secondary education, which translates into the openness of perception and good understanding of the virtual environment), indicates that the general perception of the quality of website design is rather low. It follows that the present form of websites of telecommunication operators meets the users' expectations in slightly more than 30%.

## Conclusion

After summarizing the results of the scores, the authors arrived at average results for all mobile operators. The obtained results were influenced by the selection of the study sample and conditions of its functioning. Students are the group which has relatively the largest number of smartphones and use mobile applications most frequently. Taking the above into consideration, the group seems to be the best sample for carrying out the research. This group also has wide (probably the widest in the society) knowledge on the latest technologies and their use. The selection of the student groups is the case of purposive, random sampling, and perhaps this is the reason for the accidental domination of women and students in the early years of study among the respondents.

Addressing the group which is considered to be experts in the field of practical application of new technologies brought about interesting results for telecommunication operators in terms of user requirements concerning the websites.

Thus, 37.02% of survey participants thought that, despite the best scores for aesthetics (visualization) of the websites, the mobile operators should introduce visualization changes of medium, considerable and maximum degree (respondents opinions: … the manner of selecting tariffs needs to be changed… (…) …tariffs are arranged in such a way so as to mislead us, users, so that we can't find the best deal…). The selection of graphics calls for improvement (15.27% – …because of the excess of pictures and adverts, it's sometimes difficult to get out of the site – participant's quoted opinion) and lettering (12.60% – …regulations (small print should be more readable) additional payments need not to be hidden because they are negligible (at least in the case of my contract)… – client's opinion).

More than half of participants (54.20%) believe that the greatest problem of the websites is incorrect arrangement of elements in the website (…the sections for subscribers, mixes, card holders and search functions should be more clearly divided. It's hard to find them … – the subscriber's opinion).

Also, 69.47% of interviewees believe that the search functionality of websites of mobile operator also requires a change (of medium or considerable degree) (…it's hard to find useful information, access the subscription offer without a telephone, the first page presents mainly ads which interfere with finding important information (…) …the first option should be selecting telephone options, subscriptions for companies should be presented later … – clients' opinions).

More than 47% believe that the websites of mobile operators are not easy to use (…the website should be more user-friendly, very often I can't find the information I am looking for because it is hidden... – the respondent's opinion).

The content of particular components may also raise doubts (…the duration of the agreement, the discounts, etc. (…) information about the offers for individual clients … – client's opinion).

The websites of telecommunication operators are not free from technical problems – 33.59% of respondents indicate that websites operate "rather efficiently". 47.33% of survey participants claim that this is due to access methods – they most frequently use a mobile phone/smartphone and laptop rather than a desktop PC with a large monitor for which websites have been designed for years.

The above examples show that in terms of design, modification and realization of websites of telecommunication operators there is still much room for improvement.

An additional limitation of this phase was that the present study was intended as a general analysis of the use of mobile operators' websites and the authors had to focus on the total scores of websites' use evaluation. This generalization may lead to erroneous conclusions. The second phase of the research will concern the websites of particular telecommunications operators, which, on the one hand, allows for clarification of conclusions, and by way of comparative analysis, for the creation of the ranking of websites and, consequently, on this basis, distinguishing the best models for designing such websites. Therefore, supplementing the present research with additional analyses will make it possible to draw further conclusions concerning the relations between operators and their websites, mobile devices and websites offering mobile applications, which is the ultimate goal of the project.

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Chapter 4

# Application of Semantic Web technology in an energy simulation tool

*Iman Paryudi, Stefan Fenz*

## Introduction

It is widely known that energy consumption by buildings produces $CO_2$ emissions. Almost 40% of the total $CO_2$ emissions can be traced to this source [Schleuter, Thesseling, 2008]. Consequently, the energy consumption by buildings must be reduced and multiple actions have been taken by many countries to accomplish this. One example is the issue of Directive 2002/91/EC by European Parliament that requires the member states to regulate the building development activities in Europe. The only buildings given approval for construction are those complying with the energy performance standard stated in the Directive [Europa, 2007]. In the U.S., the Net-Zero Energy Commercial Building Initiative was issued in 2008 with the goal to have net zero energy buildings by 2025 [Logan, Klaasseen, 2010].

To reduce the energy consumption, the building must be designed so that it is energy efficient, and to achieve this, an energy simulation tool is needed. An energy simulation tool is a tool to predict energy consumption by building that is used to heat or cool it in order to maintain thermal comfort of building occupants [Paryudi, Fenz, 2013]. Architects as one of user group of energy simulation tools has their own preferences on characteristics of an energy simulation tool due to their limitations in simulation field. Architects prefer energy simulation tools having simple user interface design and alternative designs feature. In relation to this, we have developed an energy simulation tool that is intended for Architects as the primary users. The system has simple user interface design and alternative designs feature to accommodate the preference of Architects.

This paper will discuss the features of our system, i.e., simple user interface design and alternative designs. First, we will describe the system's user interface design. After that, we explore the application of Semantic Web technology in an energy simulation tool to extract Web data required in the optimization process. The last part of this paper will discuss the optimization itself.

## 4.1. User interface design

The user interface is designed after reviewing user interfaces of several existing energy simulation tools. It is also designed based on principles of good user interface design. In the final design, the user interface has several features [Pont et al., 2013]:

a. Two-dimensional plans of building floors can be drawn on a grid. Besides drawing, users can also copy plans from previous floors (Figure 4.1);
b. Doors and windows can be added on the plans by using the provided drawing tools (Figure 4.1);

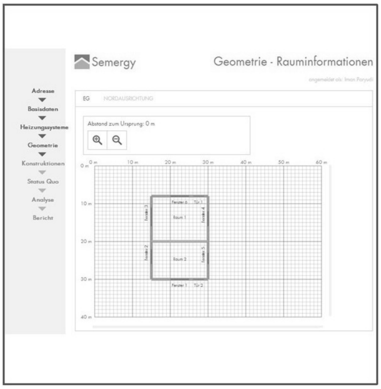


**Figure 4.1.** Feature to draw 2-D building plan including windows and doors

c. The attribute of the spaces can be added by simply selecting a predefined list of space functions (Figure 4.2);

**Figure 4.2.** Assignment of space function to the building plan

d. The building can be oriented easily by rotating the building plan on a Google Map (Figure 4.3).

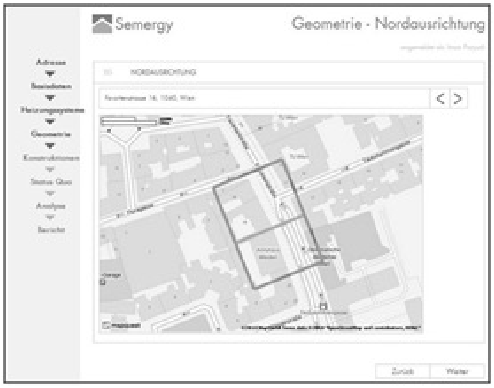


**Figure 4.3.** Feature to define the building orientation

To determine its usability, a usability evaluation is carried out on the user interface. The evaluation of the user interface design is performed by applying a heuristic evaluation method [Shneiderman, Plaisant, 2005], which is carried out by reviewing the design, judging its quality, and suggesting alternative design elements for designs needing improvement [Chalmers, 2001]. The judgment of quality is based on the design's conformance with heuristics [Shneiderman, Plaisant, 2005]. For this evaluation's heuristics, we used Shneiderman's Eight Golden Rules of User Interface Design and added with cognitive psychology theory. More detail discussion on Shneiderman's Golden Rules and cognitive psychology theory can be found in [Shneiderman, Plaisant, 2005; Paryudi et al., 2014], respectively.

From the evaluation, several usability problems are found in the user interface design including layout inconsistencies. Several designs are inconsistent from one to another. The user interface also has a usability problem in that it does not provide enough information to users and does not prevent error when the user is inputting data (i.e., no validation on the inputted data). The colour scheme used in the design lacks adequate contrast between the font and the background colours making it difficult to see the information on the screen. And sometimes the design is too long hence reducing the motor speed.

## 4.2. Data extraction using Semantic Web technology

The role of Semantic Web technology in the developed system is the extraction of data on the Web that is needed to select alternative designs. To do this, the data must be first semantified-in order to be machine-readable-and connected to each other. This ontology can then be extracted through queries with certain constraints to obtain the required data. The data resulting from the queries will be processed further by the optimization method to achieve better alternative designs.

The ontology is created mainly based on Baubook. The Baubook Web platform is "a database of building materials with their ecological and physical properties" [Mahdavi et al., 2012]. The data contained in the Baubook is divided into several categories (Figure 4.4) that will be used as the main hierarchy in the ontology. The process to semantify the Baubook to create the ontology is explained by Shayeganfar et al. [2013].


**Figure 4.4.** Categories in Baubook

The first step in creating the ontology is conversion of Baubook data format-that is published in XML-to RDF format using RDFizer component. The converted data is used as the main hierarchy of classes in the ontology (Figure 4.5). The same happens for all of the listed Baubook products (Figure 4.6), which are also converted to RDF format. Since the Baubook products' properties still do not meet the requirement for the simulation process, for the next step Shayeganfar et al. [2013] add the ontology with the following data:

a. Addition of required product properties that will be used in the further simulation process, e.g., product's resistance. This is important since it can reduce calculation load in the later step of the simulation process. The resulting conversion of the Baubook products and the additional properties are shown in Figure 4.7.

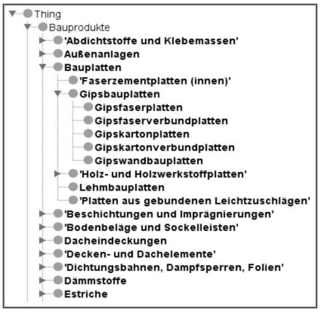


**Figure 4.5**. Semergy hierarchy as a result of conversion from Baubook categories

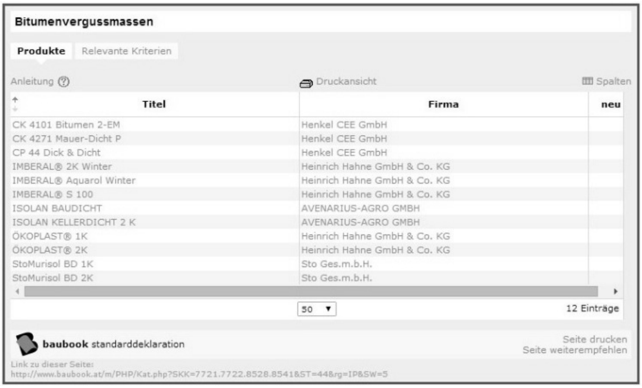


**Figure 4.6**. Example of Baubook products


**Figure 4.7**. The resulted conversion of the Baubook products and the additional data

b. Function, Position, Format, and Material of the products. This information is needed to create rule-based logic and will be used by rule-based reasoner to check whether a product is suitable for use in a certain part of the building. For instance, a product that is not water resistant must not be selected for an external wall. Such data include: i) The function of the products. The functional categories can be insulation, load-bearing elements, protective foils, etc. ii) The position of the product. The position can be in wall, roof, or ceiling. iii) The format of the product. It can be a block, plate, foam, etc. iv) The material of the product, whether it is made of wood, concrete, glass, metal, etc.
c. For each category in the Baubook, the two most common products are selected as default products-one each for novice and expert users. The difference between the two default products is that the one for novice users uses a name that is common to the public. Meanwhile, the one for expert users uses more technical terms. An example is shown in Figure 4.8. This default product selection is done by connecting its instance-the product's representation in the ontology-to Baubook classes by adding annotation properties in the target classes.


**Figure 4.8.** Default products for novice and expert users

To reduce the optimization process, the application must extract only relevant data. To do that, it provides a semantic data interface to connect between computational methods and the semantic repositories. According to Heurix et al. [2013], the semantic data interface has two functions:

a. Translate all constraints and requirements into semantic queries in SPARQL format.
b. Map the extracted RDF data and query results to related fields in the building model.

To show example of semantic data interface in creating a query, Figure 4.9 that depicts layers of a wall is used. The created query for the Façade layer is shown in Figure 4.10. Shayeganfar et al. [2013] explain that this query will then fetch all data in the ontology and the related data on the Baubook repository that matches the constraints. The same will be done for other layers. Alternative layer constructions can be obtained from the Cartesian product of the query result. If the number of alternatives after this step is still substantial, then another filtering can be done by using cost as the constraint.

| Layer Name | Properties |
|---|---|
| 1. Interior finish | Format: Plester<br>Material: Gypsum, Lime, …<br>Misc.: Wall-suitable |
| 2. Brickwork | Format: Block, …<br>Material: Brick, Stone, Beton<br>Misc.: Non-deformable, … |
| 3. Insulation | Format: Plate, Mat, Foam<br>Material: Cork, Sheep wool, …<br>Misc.: Wall-suitable |
| 4. Rear-ventilation | Format:<br>Material: Air<br>Misc.: |
| 5. Facade | Format: Plate, …<br>Material: Wood, Glass, Metal, …<br>Misc.: Moisture-resistance |

**Figure 4.9.** Layer data of a wall

```
SELECT ?product ?name
WHERE {
   ?product a semergy:Plate.
   ?product a semergy:Wood.
   ?product a semergy:Glass.
   ?product a semergy:Metal.
   ?product a Moisture_resistance.
   ?product rdfs:label  ?name .
} LIMIT 20
```

**Figure 4.10.** Query for façade layer

## 4.3. Optimization using Genetic Algorithm

For the optimization, Mahdavi et al. [2012] explain that building products resulting from the query in the previous processes are used. The goal of the optimization is to find alternative designs that are better than the initial user design in terms of one or all of the following objectives: heating demand, investment cost, and environmental impact. The way to find alternative designs is by making various combinations of the available building products for each building component. Before the combination process, the available building products are distributed into several classes-called candidate classes-in order to ensure that a building product for a certain building component is not used for other building components-e.g., a product for a wall is not used for a window or door. This process is then followed by calculating the heating demand, investment cost, and environmental impact of each combination.

However, there is a trade-off in the optimization process. On the one hand, the heating demand, investment cost, and environmental impact need to be minimized. On the other hand, to achieve low heating demand and low environmental impact, the material quality used by the building must be maximized and hence increases the investment cost. In this multi-objective optimization, different trade-offs between each objective produces a set of optimization solutions. This set of solutions is called Pareto front and the optimization technique is called Pareto optimization. Due to the nature of the problem, Heurix et al. [2013] apply Genetic Algorithm to solve this optimization issue. An example of solving this optimization problem can be seen in [Heurix et al., 2013]. The alternative designs resulting from the optimization process are usually still too numerous, and hence need to be filtered further. To help its users accomplish this, the application provides a feature to enable the users to modify the aforementioned objectives. Figure 4.11 illustrates this feature.

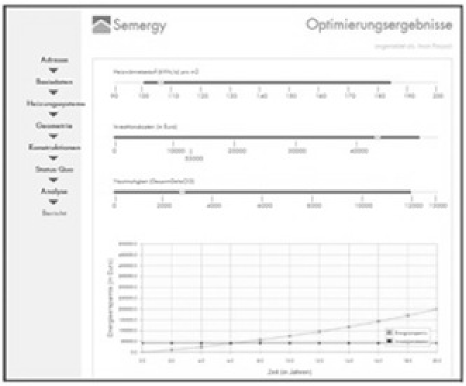


**Figure 4.11.** Feature to modify the optimization results

## Conclusion

In an energy simulation tool, a feature that provides alternative designs that are better than the initial user design is very important. This is to allow the user to choose the best design. In doing so, a number of building related data must be available so that the application can make various alternative designs based on that data. Such data is available freely on the Web. Since the data is not ready to use, it must be processed first before being used. Manual process will consume a lot of time so not worth doing. A solution of this problem is the application of Semantic Web technology to automatize the extraction of the data. This extracted data is then used in the optimization process to find alternative designs. The goal of the optimization is to find alternative designs that are better than the initial user design in one or all of the following objectives: heating demand, investment cost, and environmental impact. Since this is a multi-objective optimization, the application uses Genetic Algorithm as a method to solve this optimization problem.

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## Acknowledgements

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Chapter 5
# Automated translation systems: faults and constraints

*Karolina Kuligowska, Paweł Kisielewicz, Aleksandra Rojek*

## Introduction

Automated translation, also known as machine translation, is based on automatically realized machine translation of text in one language (source language, SL) into text in another language (target language, TL). This field is also referred to as TTTL – Translate Text To Language.

Linguistic and philosophical ideas of creating a universal language and mechanical dictionaries date back to the seventeenth century. They remained a pure theorizing until the forties of the twentieth century, when technological improvements led to the first practical inventions. In 1949 Warren Weaver encouraged American scientists to build a computer-based translator. The first automatic translator, in a very basic form, was constructed in 1954 by researchers from Georgetown University in collaboration with IBM. The machine was able to translate at a time around sixty Russian sentences into English [Cheragui, 2012, p. 161]. This implementation started years of subsequent researches, concepts and discoveries in the field of machine translation. Nowadays, machine translation is present in everyday life and available at least for every Internet user [Hutchins, 1995, p. 431–445].

Automated translation system should be able to analyse all elements of a sentence in order to interpret its meaning and the context of used words. At the basic level, the system performs simple substitution of words. However this process cannot bring good results, because it is necessary to recognize whole phrases and their closest counterparts in the target language. Every natural language has its own grammatical structure and rules which have to be followed by machine translation systems. This requires extensive linguistic knowledge of grammar, syntax and semantics – not only in the source language, but also in the target one. For that reason, the biggest challenge is to create a translation module which could generate high-quality translations without the need of human intervention.

The aim of this paper is to present automated translation systems and to examine their drawbacks and limitations. The paper is organized as follows. Section 1 presents a brief review of machine translation approaches. Section 2 describes functioning of existing machine translation systems along with their architecture. Section 3 analyses faults and constraints of machine translation systems. Finally, the last section presents our conclusions.

## 5.1. Approaches to machine translation

Over the years of the development of machine translation, researchers have been adopting various approaches to this issue. The most general classification distinguishes three following approaches: rule-based approach, corpus-based approach and hybrid approach [Cheragui, 2012, p. 163–165; Langa, Wojak, 2011, p. 5; Tripathi, Sarkhel, 2010, p. 389–391].

### 5.1.1. Rule-based translation

Rule-based translation is based on a built-in set of linguistic rules, previously elaborated by linguists. This approach also includes gigantic bilingual dictionaries for each language pair. Rule-based translation system parses the source text and creates its temporary representation. Then, using a set of appropriate rules and transformations of grammatical structures, the temporary representation is reformulated into text in the target language. This process requires a comprehensive set of grammar and linguistic rules as well as extensive lexicons which contain morphological, syntactic and semantic information.

In this approach it is possible to achieve a good and very good quality of translation. The translation is coherent and predictable, even though it can be shorn of smoothness expected by readers. We have to be aware of the fact that the process of improving the quality of the translation has to be long and expensive. On the other hand, rule-based translation efficiency is high, even when realized on the standard hardware.

Rule-based translation constitutes the basis of following methods:

- direct translation approach,
- transfer-based approach,
- interlingual approach (i.e. translation using artificial intermediate language).

The clearest explanation of the complexity of the rule-based translation methods is presented on so-called Vauquois triangle illustrated in Figure 5.1.

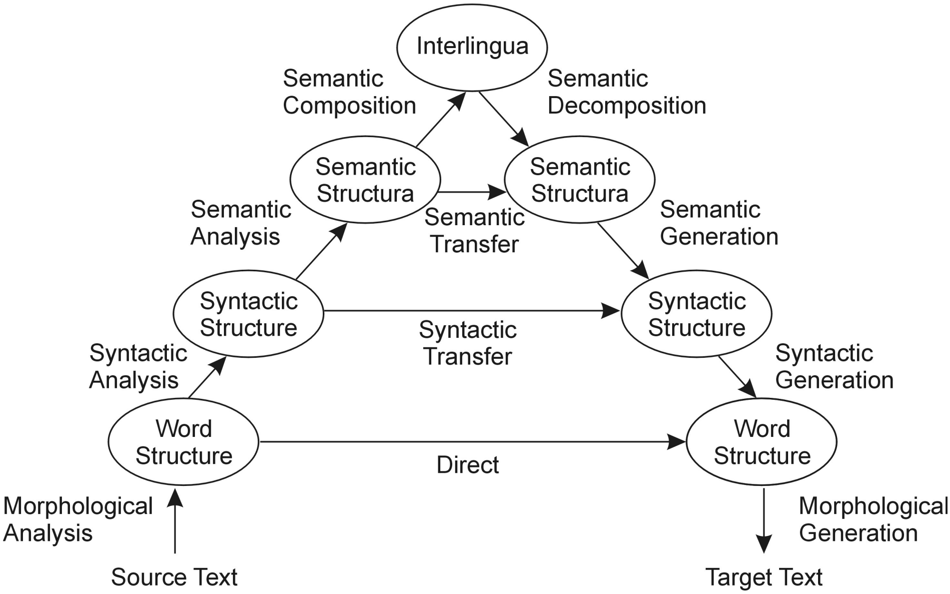


**Figure 5.1.** The Vauquois triangle
Source: [Dorr et al., 2005, p. 2].

The Vauquois triangle shows that the most basic method, which is direct translation, includes a low level of analysis and requires extensive knowledge about the structure of the word. When moving from the base to the apex of the triangle, one can observe an increase in the required level of analysis with a simultaneous decrease in the demand for knowledge about the structure of the word. Therefore selection of the method influences the level of depth of analysis on the one hand, and the extension of the knowledge and linguistic diversity on the other hand.

### 5.1.2. Corpus-based translation

Corpus-based translation is based mainly on existing multilingual corpora. They contain a minimum of 2 million words per specific field, and even more for colloquial language translations. In corpus-based translation approach it is possible to achieve a translation on a high level of quality, but sometimes the translation might be inconsistent and unpredictable. Unfortunately, most companies do not dispose of sufficiently large multilingual corpora, which are necessary in the process of building and training translation models. What is more, translation requires a significant amount of processing power. To achieve even average performance, expanded hardware configuration is necessary. However, if the company has adequately large multilingual corpora, process of quality improvement is fast and cost-effective.

Corpus-based translation is the basis of the following methods:

– statistical machine translation (SMT),
– example-based machine translation (EBMT).

Statistical machine translation uses statistical models that generate the most likely translation based on corpus, which is a large database of translated texts. In this method statistical correlation tables assign, on the basis of probability, words, sentences and phrases from the source language to their counterparts in the target language. Building statistical translation models is considered as a relatively fast process and does not require implementing a set of grammatical rules.

Example-based machine translation is a form of "translation by analogy" and it can be perceived as machine learning system which includes case-based reasoning. Examples are located in bilingual corpora, containing pairs of analogical sentences in the source and target language. These sentences simplify process of model training.

### 5.1.3. Hybrid translation

Hybrid translation combines strengths of previous approaches. Its aim is to achieve a very good level of translation quality and high efficiency on a given hardware (as in rule-based translation) while ensuring low investment costs (as in statistical translation).

## 5.2. Functioning and architecture of automated translation systems

### 5.2.1. Rule-based systems

In the direct translation system the translation process is based on the knowledge of the source language and knowledge about how to transform parts of analysed sentences in the source language to sequences of sentences in the target language. The architecture of this basic approach to automatic translation is illustrated in Figure 5.2.

On the other hand, in the transfer-based system translation requires extensive knowledge about the source and target languages, as well as about the connection between the analysed sentences in both languages. Therefore, the architecture of this system is also called linguistic knowledge architecture.

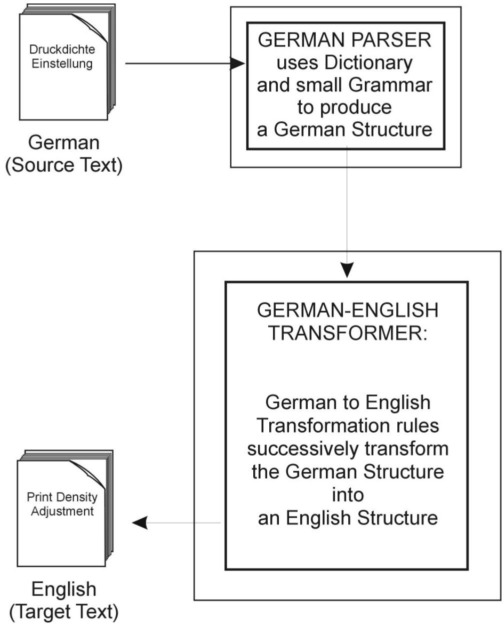


**Figure 5.2.** The architecture of a rule-based direct translation system
Source: [Arnold et al., 1994, p. 60].

The architecture of a transfer-based system is shown in Figure 5.3.

As it can be seen in the Figure 5.3, the architecture of a transfer-based system requires two components:

- analysis, which contains an impressive set of grammatical rules of the source language and the target language; these rules are used by parsers for the analysis of sentences in the source language and for transferring them into a symbolic representation,
- synthesis, which connects each representation of the sentence in the source language with a corresponding representation of the sentence in the target language. This representation is the basis for generating a translation in the target language.

The most complex rule-based system, i.e. interlingual system, represents a higher level of analysis than transfer-based approach. It uses so-called interlingua, an artificially created intermediate language. The architecture of an interlingual system is illustrated in Figure 5.4.

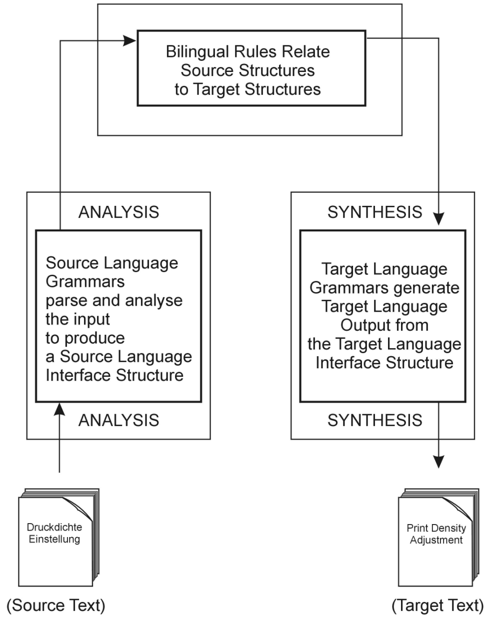


**Figure 5.3.** The architecture of a transfer-based system

Source: [Arnold et al., 1994, p. 68].

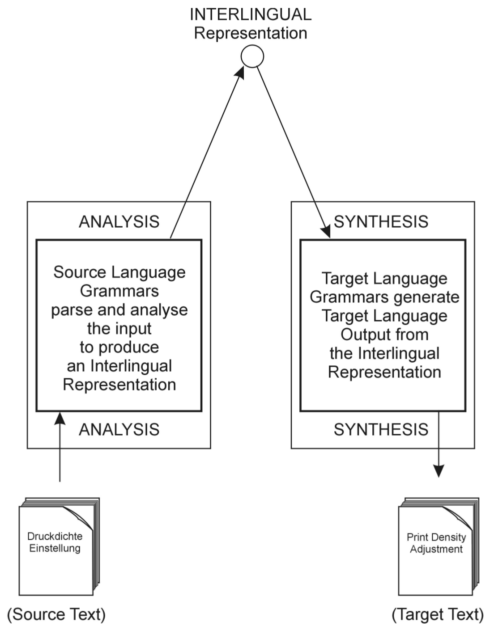


**Figure 5.4.** The architecture of an interlingual system

Source: [Arnold et al., 1994, p. 79].

### 5.2.2. Corpus-based systems

Statistical machine translation (SMT) system makes a decision that is connected to probability. Among whole sentences in the target language, SMT system must find the most likely translation of a given source sentence. The probability that the target sentence is the adequate translation of the source sentence is calculated on the basis of earlier learning of the model on small segments (sequences of words) of bilingual corpus of texts. Thus, in this approach whole translation constitutes a sum of shorter fragments translation.

Figure 5.5 illustrates the basic architecture of the SMT system. SMT translation involves two main stages: 1) training, during which the system is taught from available translation examples, and 2) testing, during which the new sentences are translated.

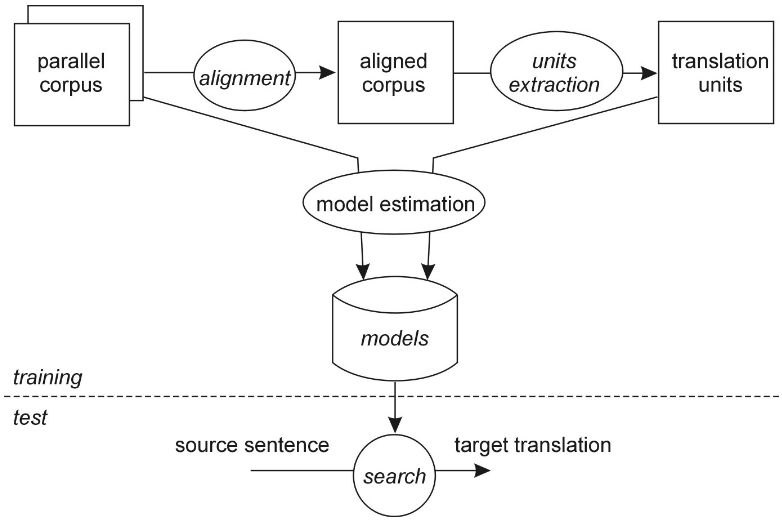


**Figure 5.5.** The architecture of statistical machine translation system

Source: [Crego Clemente, 2008, p. 5].

Training stage starts with sentence-to-sentence parallel corpus alignment, and continues with determining pairs of counterparts generated automatically by word-to-word alignment. This process is also called as "text binding" [Lewandowska-Tomaszczyk, 2005, p. 43]. Then, translation units (phrases) are automatically extracted from a parallel training corpus. They are used in the testing stage while generating new sentences. Finally, the last stage is phrase scoring. In this step, the translation probabilities are computed and scored for all phrase pairs [San-Segundo et al., 2013, p. 66]. While searching for a sentence with the highest translation probability, there are used several models responsible for adequacy and smoothness of translation.

Example-based machine translation (EBMT) system is based on intuitive assumption that people use already existing examples of translations in order to translate new input. If such system has to function properly, it must include bilingual corpus of parallel examples (their other name is "bitext" or example-base) to translate each part of a sentence. EBMT is based on previous translations in order to generate further translations. This process is broken down into three stages:

– matching,
– alignment,
– recombination.

The matching module finds an example or a set of examples from a parallel corpus, that matches best to the sequence of words in source language. The alignment module identifies equivalents within the string of "source-target" words from examples extracted previously during the matching stage. Recombination generates the final translation by putting together essential parts of the translation in the target language. Figure 5.6 illustrates the architecture of the example-based machine translation system.

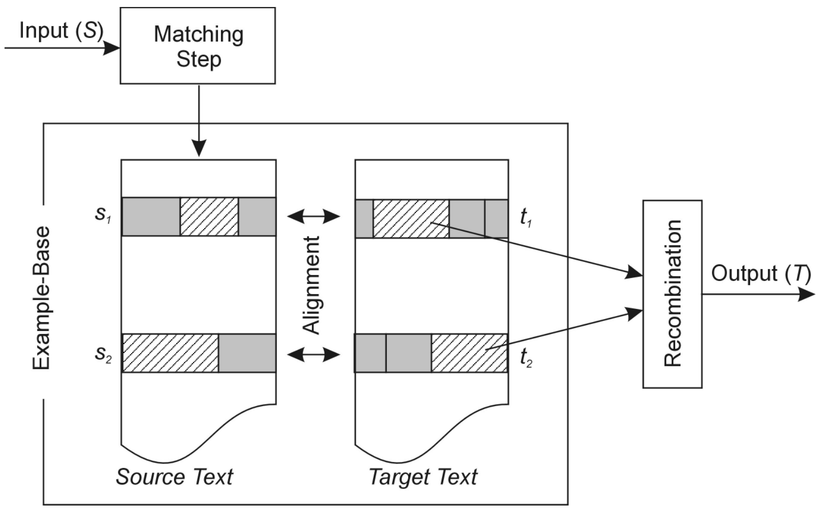


**Figure 5.6.** The architecture of the example-based machine translation system
Source: [Dandapat, 2012, p. 12].

## 5.3. Faults and constraints of automated translation systems

Automated translation systems make a lot of mistakes that almost never occur in case of human translations. Professional translator is more aware of the context and other important aspects of the translation. All of these limitations related to machine translation differ depending on the translated language pair. When two translated languages are profoundly dissimilar, then these errors are critical.

### 5.3.1. Ambiguity

One of the problems in machine translation is ambiguity which usually refers to vocabulary and language structure. What is more, those two types of ambiguity have the most impact on the quality of the translation. Ambiguity related to vocabulary occurs when words have multiple meanings. Ambiguity of the language structure results from the fact that we can interpret the same sentence in multiple ways.

### 5.3.2. Accuracy

Accuracy in machine translation is not always on the same level. Most systems translate word for word without understanding translated information. If we do not take into account the meaning of the text, the most common result is a general outline of the translation. Such translation has to be corrected by human.

### 5.3.3. Context

Automated translation systems cannot use previous experience in a way that human translators do it. In languages such as English, one word can have hundreds of different meanings depending on the context. Therefore, in order to properly translate the text, a system should take into account the intersentential context. As a result we should obtain a coherent multi-sentence text in target language. Unfortunately, machine translation has not yet reached the level that would allow to understand the whole intersentential syntactic context.

### 5.3.4. Training corpuses and machine learning

Performance of machine translation depends on training phase, therefore it might suffer from the problem of data sparseness. In case of small amount of training set, there is a problem of data prediction. This requires wide coverage of full lexicon of source and target language. Problem also occurs when the training data is from one domain, and system is applied to operate in some other field. Although parallel corpora are becoming increasingly available for various language pairs, the size of such corpora for the most language pairs are limited [Sugandhi et al., 2011, p. 3].

In order to achieve machine translation quality close to the human translation level, translation models must be able to recognize complex syntax and semantic representations and their equivalents in various languages. The key task of model learning in this case is to identify correspondence between structures in two languages and to model these connections statistically.

More difficult thing is to teach models using parallel data, where the syntax and semantic structures are available only for one of the two languages. The model learning task in this case is to project structures from one language to the their corresponding structures in the second language using word-to-word correspondence. The problem lies in obtaining needed training resources. The development of annotated training corpora is a necessary step without which researches on the development of such machine learning system cannot even begin [Sugandhi et al., 2011, p. 5].

### 5.3.5. Language constraints

There are four most important language constraints which occur during machine translating process [Sugandhi et al., 2011, p. 4–5]:
1) cultural differences,
2) changes in linguistic theory,
3) morphological complexity,
4) researches focused only on English.

**Cultural differences**

Cultural differences are a problem in current machine translation systems. The bigger difference between the source and target culture, the more problems arise while translating. Some words associated with one culture do not have their equivalent words in other languages. For example, the Indian word "sari" (traditional dress of Indian women) often has no equivalent word in other languages [Sugandhi et al., 2011, p. 4]. Here occurs a problem of untranslatability of individual words, with which often cannot cope even professional translators.

Another language problem, in the context of cultural differences, constitute unknown words. Unknown words are the source language words which are not included in the training data, and thus have no equivalent in the target language. The current machine translation systems usually omit such words, or leave them in their original form. This is justified in the case of names (assuming you do not have to make transliteration), but neither the omission of the word, nor leaving it in its original form, is a satisfactory solution. It is well known that unknown words issue significantly influences the quality of translation. This problem can be particularly severe when the available bilingual data is very small. First of all, it is difficult to find the meaning of these words in the target language. What is more, the unknown word can negatively affect the lexical selection and reordering the words around it. The conventional solution to the problem of unknown words is to find their equivalents in the target language with additional resources, such as multilingual data, web data or linguistic resources such as WordNet. However, most of these methods can cope only with certain types of unknown words, such us named entities, abbreviations, compounds or morphological variants. Therefore, problems connected with unknown words still remain unsolved. Moreover, the translation of such words with which the system copes, might not help in the lexical selection and reordering of the surrounding words because translation is obtained for other re-sources than the original bilingual training data [Zhang et al., 2012, p. 176–178].

Another constraint which depends on culture is translation of idioms. Idioms are defined as a multi-words expressions with constant sense (often metaphorical), meaning of which cannot be fully understood from the individual meanings of its elements. One of the issues that concerns precisely this kind of expressions is their ambiguity, so thus they can be interpreted literally and metaphorically. Some part of idioms can be translated word for word, provided that a similar expression exists in the target language. However, in cases when there is no similar idiom in target language, such translation is not possible. Very often this type of expressions are culturally limited, which means that they can exist only within one country or even a small region. Therefore, it is very difficult to transfer them into totally different cultural context. One method for translating these idioms is to find idioms in the target language with a similar meaning and form, or similar meaning, but different form. It is also possible to use a paraphrase. If idioms have no close counterparts, system can simply omit them [Gaule, Josan, 2012, p. 51]. Unfortunately, in many cases systems still cannot cope with this kind of expressions. Idioms require specific, separate rules, obviously in addition to the standard rules that apply to "ordinary" words and other linguistic structures.

**Changes in linguistic theory**

The development of machine translation, considered from the point of view of system performance, has to go hand in hand with the development of linguistic theory. However, this is difficult to achieve in practice, since modification of the knowledge base is not easy, especially when it comes to the colloquialisms. This results in a large communication gap between theoretical linguistics and practical research in machine translation. We also must take into consideration acronyms and official words which we use in translation, especially in multilingual translations. Acronyms are difficult to translate due to the fact that different letters are used in various languages, often in a changed order. This can be avoided in the future if they will be replaced by acronyms accepted in many languages [Sugandhi et al., 2011, p. 4].

**Morphological complexity**

Each language has a different level of morphological complexity. When it comes to English, the morphology is quite simple. Therefore, recent research in machine translation has paid only limited attention to issues of effectively handling complex morphology. All methods of machine translation tend to retain the structural characteristics of the source language, despite the fact that they should be more oriented toward the target language. In a multilingual machine translation various methods of translations for different target languages are implemented. To change this, researchers have been developing new translation models that effectively cope with complex morphology. The issue of data sparseness should be also taken into account [Sugandhi et al., 2011, p. 4–5].

In the source literature there are also mentioned several open and long-term challenges that need to be solved in the near future of automated translation [Lopez, Post, 2013, p. 2]:

- translation of sparse language pairs,
- translation across different domains,
- translation of informal text,
- translation into morphologically rich languages.

**Researches focused only on English**

USA is the heart of development of computer technology. However, this is one of the most homogeneous societies in the world in terms of language. For this reason, most of the linguistic theory of machine translation is based on phenomena observed in English. In addition, statistical machine translation is focused on a small number of language pairs for which huge amounts of sentence-aligned parallel texts have become available. Theories such as Lexical Functional Grammar or Generalized Phrase-Structure Grammar and their various derivatives were intended to cover as large range of languages as possible, not only within one specific language, but also for different types of languages.

When comparing various languages to English, they differ in a writing system, grammatical structure, and in a way of expressing similar meanings and intentions. Many world languages use some variant of the Latin alphabet, including particular special characters, or a totally different writing system than English. Additionally, languages such as Arabic, Persian and Hebrew are written from right to left, while Japanese and Chinese may be written from top to bottom [Sugandhi et al., 2011, p. 4–5]. All these issues need innovative computing solutions.

A particular challenge in machine translation are less popular European languages, which are characterized by rich morphology and language structure. For economic reasons, current commercial activities focus exclusively on the most widely spoken languages. For example, despite the fact that Google Translate covers more than 70 languages, the quality of translation of e.g. Baltic languages is much worse than English, French, Spanish. Languages that are not widely used, need special attention and detailed researches.

## Conclusion

Although machine translation is a rapidly developing technology, there are still some limitations in the current automated translation systems. They mainly relate to variability of semantic meanings, which is conditioned by historical, cultural and civilizational factors. Automated translation problems also arise from the syntax differences between source and target language. In addition, machine translation systems often cannot cope with homonyms, synonyms and metaphors. There are also other issues to encounter, such as: recognition of the context of translated sentence, cultural differences between pairs of translated languages, changes in linguistic theories and morphological complexity of many natural languages. Unfortunately, extensive development of machine translation is not facilitated by researches strongly focused on English, which is the twenty-first century Latin.

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Chapter 6
# An overview of IT tools protecting intellectual property in knowledge-based organizations

*Dariusz Ceglarek*

## Introduction

The changes that occur in organizations' environment cause views on the major factors that contribute to the success of these organizations to naturally evolve, regardless of how this success is defined. One of the most important issues in this regard is how to create a durable competitive advantage on the market. This encourages organizations to use more sophisticated management strategies and methods and gain relevant and unique skills and competencies. As a result of the process of economic globalization, technological progress and rapid information flow, etc., competing companies are often similar to each other in terms of the resources that they use as well as collaboration with suppliers and ways of influencing customers, etc. It turns out that traditional sources of success, i.e. products, technological progress and access to financial resources, are somewhat declining in importance, while a company's non-material resources, which are a decisive factor in determining competitiveness, are becoming increasingly important.

The ability to generate innovations and quickly obtain desired information are becoming the main determinant of success and competitive advantage as well as to increase the effectiveness and profitability of any organization (including companies). A company's value is to an increasingly lesser extent determined by its material resources and to an increasingly larger extent determined by its ability to use non-material resources, and in particular information resources that create intellectual capital which should be built in such a way as to increase the company's market value as much as possible, to let it gain a competitive advantage on the market and maintain the best possible relations with customers. However, innovation cannot be accomplished solely by skilfully identifying, creating and expanding knowledge along with developing key competencies. If one wants to derive benefit from knowledge management, and not only put effort into this process, one must be able to put new knowledge into practice.

Intellectual activities related to the gaining of knowledge by organizations and the creativity involved in establishing valuable and unique relations are factors that stimulate the formation of intellectual capital. As part of organizational knowledge management it has been proposed that knowledge resources be publicly available. However, among an organization's information resources there is also sensitive information as well as information that must be protected from falling into the wrong hands. Therefore, knowledge resources are subjected to the rigors of the appropriate security policy, which should prevent information leaks or other forms of infringement of an organization's intellectual property rights.

Due to widespread electronic storage, processing and transfer of information, IT systems which are specially designed for this purpose are being more frequently used to protect corporate information resources. This article deals with the topic of IT systems and the mechanisms that they use to protect intellectual capital of organizations. These systems are aimed to ensure proper information flow. What is more, this article takes up the issue of detecting violations of intellectual property rights where a valuable piece of information is public and cannot be protected against unauthorized use.

Finally, the paper presents a systematic description of the categories of financial losses incurred by an organization due to information security breaches as well as methods for measuring costs incurred as a result of intellectual property security breaches. Moreover, it also describes factors that should be taken into account when determining the value of particular components of an organization's information resources, which is estimated in the context of infringement of intellectual property rights.

## 6.1. Intellectual capital

Intellectual capital, which is a part of the non-material, intangible resources, is made up of human capital and structural capital which comprises structural capital that is internal (the methods and processes that allow a company to function) and external, i.e. relational capital (a company's potential that is connected with intangible market assets which consist of, e.g. customers and customer loyalty, contracts, licensing agreements, concessions, marketing strategies, pricing strategies, and distribution channels).

Human capital is the part of intangible assets that is not a company's property. When leaving a workplace, employees take these assets with them [Edvinson, 1997]. Human capital comprises, most of all, the employees' knowledge, their skills as well as creativity and willingness to introduce innovations. According to *Brookings Institute*, intangible assets accounted for 38% of companies' average market value in 1982, whereas in 2002 this figure reached as much as 88%.

The concepts of knowledge management in an company include topics such as organizing the process of obtaining and storing knowledge as well as efficient knowledge management, and aiming to build such mutual dependencies between systems used for storing and managing knowledge so as to create a structure that will ensure maximum productivity of knowledge [Kubiak, 2009]. Currently, the organizational structure should depend on the context in which a company operates and it should be designed in such a way as to take into account both a company's material resources and knowledge resources. Such a structure should make it possible to efficiently obtain and constantly update knowledge as well as to enable organizational learning so that intellectual capital will contribute to an increase in effectiveness and will lead to achieving corporate objectives [Ricceri, 2008].

Intellectual capital management entails identifying, measuring, using and developing a company's hidden potential, which has a direct influence on management effectiveness. Proper management of intellectual capital is one of the key competences of contemporary companies. Therefore, the main aim of intellectual capital management is to recognize (identify) particular elements of intangible assets, measure them as well as use and develop them properly in order to achieve a company's strategic objectives [Meyer, de Witt, 1998].

In a modern company it is the people that are in the center of attention as they form the basis for creating human capital and whose will and needs provide inspiration for generating knowledge. This knowledge is then processed, transferred and disseminated through interpersonal contact within a company.

Structural capital can be divided into customer capital and organizational capital which, in turn, can be divided into innovation capital and process capital. Innovation capital comprises intellectual property and other intangible assets. Intellectual property is made up of patents, copyrights, design rights, trade secrets, trademarks, and distinctive business services [Edvinson, Malone, 2001].

The concept of intellectual property was defined by World Intellectual Property Organization (WIPO), according to which intellectual property in particular refers to: literary, artistic and scientific works, interpretations by artists and interpreters as well as performances of performing artists, phonograms, radio and TV broadcasts, inventions in all fields of human endeavour, scientific discoveries, industrial designs, trademarks and service marks, commercial names and protection against unfair competition.

Legal protection of intellectual property is subject to relevant regulations in every country and it covers copyrights and related rights, database protection, industrial property rights (inventions, utility models and industrial designs, trademarks, geographical indications, and an integrated circuit topography) and combating unfair competition.

The above-mentioned innovativeness in any company that is based on knowledge is the result of previously carried out expensive research and development activities. In a knowledge-based economy the protection of intellectual property becomes a strategic issue when various business decisions are made. Legally registered knowledge, is protected by patent law which, at the same time, increases the tendency to create inventions and expands knowledge as a public good. Therefore, commercialization of valuable inventions must also be beneficial to the patent holder who has a temporary monopoly on using an invention [Burk, 2004].

## 6.2. Mechanisms protecting intellectual capital

Apart from intellectual property, which is subject to patent protection, organizations also have tacit knowledge, that is, know-how, and knowledge which is not subject to registration. When trying to protect the accumulated knowledge that constitutes their corporate intellectual capital from leakage, organizations create isolated and strongly protected islands of knowledge by using various technologies and security methods. One of the most important security functions today is the protection of organizational secrets and confidential data from intentional or accidental leakage. According to research conducted by network security manufacturers [Jaquith et al., 2010], loss of confidential data and company data is the second most serious threat after that of a computer virus attack. Contemporary organizations mostly store their information resources electronically in mass storage systems and databases, apart from the data that is stored on paper. The data contained in them are transmitted *via* corporate networks as well as the Internet and are transferred by using different kinds of data storage devices. For this reason there is a risk that sensitive corporate data could fall into the wrong hands. According to Forrester Research, 80% of all security breaches happen accidentally, that is, unintentionally [Jaquith et al., 2010]. In a report titled *The Value of Corporate Secrets* [2010], Forrester Research states that, in a knowledge-based industry, 70% of corporate intellectual capital is contained in tacit knowledge, 62% in finance and insurance, 41% in public administration and only 34% in health care. Naturally, the loss of hidden intellectual capital can have disastrous consequences for a company. The report revealed that employee toxic data accidents (e.g. an employee lost a laptop, an employee accidentally e-mailed or posted sensitive information) represent 57% of all incidents.

Most products that are developed by innovative companies can be referred to as knowledge-based products. The strategy that is adopted by these companies is based on fostering innovation, and knowledge creation processes may also contribute to the development of specific know-how, ways of acting, and economic processes in companies. Knowledge creation is also imperative as far as various types of state policy are concerned; in Poland these are those policy domains that are supported by the European Union. The new development strategy that is provisionally referred to as EU 2020, which was announced in March 2010, is based on three pillars, i.e. activities supporting the development of broadly defined intellectual capital (smart growth), sustainable growth and the strengthening of the labour market as well as the socio-economic cohesion of countries (inclusive growth).

The intellectual property that is contained in publicly available documents in global resources (e.g. on the Internet) is also subject to protection. The constantly growing number of such documents is a sign of the expansion of global, human knowledge, which mostly lies in the fact that new knowledge is created, as a result of cognitive processes, incrementally in relation to already existing knowledge. However, the growth of global information resources is, unfortunately, accompanied by the fact that the content of such resources is commonly used in violation of intellectual property rights. Many documents are created by using the content of source documents or modifying them by using various stylistic means that do not require any particular intellectual effort and are not a result of one's own inference, verification, argumentation or explanation. Such methods constitute a breach of intellectual property rights of such primary documents' authors.

Current IT systems which make it possible to create and use documents as well as to carry out other activities as part of corporate databases are mostly focused on effectively collecting data and documents in corporate databases, ensuring access to documents for relevant users as well as on the proper processing, search and sharing of documents which meet the conditions specified in queries sent to the system. Such systems also take care of data security through proper archiving and replication, which often takes place at the hardware level. They also monitor the basic information sharing channels in a company, for example, documents and e-mails.

Among the most popular IT tools that support knowledge management are document management systems (for archiving, search and sharing of documents), workflow systems (for supporting and unifying procedures within an organization), and group work support systems (for enhancing communication between employees, which facilitates the creation and transfer of knowledge), CRM systems, intranet, extranet, teleconferencing and e-learning tools.

## 6.3. IT tools protecting intellectual property

In many companies however, intellectual property is not only stored in well protected or encrypted repositories, but also resides on personal computers, laptops, home computers, removable storage, in cloud locations such as dropbox.com or in personal email boxes. This vast amount of big data is often unstructured, unprotected and of unclear ownership, exposing any intellectual property to risk of theft or leakage. Implementing of an intellectual property protection mechanisms is necessary to protect these important assets.

A growing number of documents kept in companies as well as the multitude of forms and formats in which data are stored make it increasingly difficult to manage and protect them properly. The most valuable information regarding companies and institutions, that is, their intellectual property, is often hidden in documents, many of which do not have the status of confidential information. Documents are repeatedly copied, transferred or even taken outside.

The employees themselves pose a security risk. It is very common that employees do not know what kind of company data are confidential or proprietary or on what terms these data can be distributed [Aberdeen Report, 2007]. One in six employees admit that they take information with them when changing their employer. Also, one in six employees say that their rationale behind taking confidential data outside is their willingness to keep the data in a safe place [Haley, 2011].

Key issues related to ensuring the security of organizational intellectual property include following aspects:

- understanding: defining the most sensitive data, defining security policy, creating appropriate metrics,
- monitoring: implementing tools for monitoring communication channels, securing documents by using appropriate techniques,
- enforcing: quarantining suspicious information, lowering the number of policy breaches to the acceptable level.

Various IT systems have been developed to protect organizational knowledge. IT tools that are directly related to other knowledge management processes, i.e. electronic communication as well as collecting, search and sharing of information, are also used to support knowledge management. Data encryption and/or additional access control are used to protect against unauthorized access to resources of this kind.

Apart from protecting an organization's intellectual property rights, tools that protect against leakage of information can also be used to protect personally identifiable information (PII), such as personal data or employees' data. These tools are becoming an increasingly important way of protecting PII against being included in the huge collections of data that are created by using the *Big Data* technology.

Such phenomena are being exacerbated because the processing of data via cloud computing is becoming increasingly popular. The requirements regarding this data processing method are being governed by increasingly strict legal regulations concerning the creation and use of personal information databases. IT tools that protect against information leaks (e.g. documents containing sensitive data) must take into account a given organization's policy related to ensuring the security of intellectual property (e.g. access rights to data and rules for sharing data as part of collaboration with business partners) and security procedures that correspond to this policy.

Next category of IT systems supporting intellectual property protection is *Unified Information Access system.* UIA systems[1] are computing systems that integrate large volumes of unstructured, semi-structured, and structured information into a unified environment for processing, analysis and decision-making. UIA systems provide unified information access to documents different formats and for services like e-mail, *Document Management Systems* etc. UIA systems combine data and content in a single universal index, maintaining data relationships – and extracting new relationships to link content and data, retrieving all relevant information with one query. The system should present results in a variety of styles and interfaces appropriate to the task, even though legacy systems (e.g. e-mail, CMS, CRM, databases and web applications) operate in isolated silos, using different formats of documents and retrieval methods. Text analytics capabilities of UIA systems include entity extraction, document classification and sentiment analysis. Some of UIA systems are capable to mitigate the risk of reputation loss and protect critical sensitive information through the structural sanitization of commonly used document formats of active content – frequently used for malicious purposes such as advanced persistent threads (APTs).

When discussing IT systems whose functionality makes it possible to prevent breaches of intellectual property rights by ensuring the security of information and applications collected in these systems, one should also mention Identity and Access Management (IAM) systems. IAM systems were created in response to the development of modern companies, which is manifested as a significant increase in the volume of information that is processed by companies' IT systems. In such a large and ever-growing IT environment, issues related to data security and access management have become the most important. Identity and access management is controlled by centralized systems which ensure the management of access rights to information resources and which make strategic planning as well as central management and control of access to information in a company possible. On the one hand, there are procedures that determine who can access information

[1] Leading-edge UIA's are: Attivo, BA-Insight, Endeca and VirtualWorks.

resources and what a given person can do with these resources; on the other hand, there are systems that supervise the implementation of these procedures and take corrective action automatically. IAM systems make it possible to, for example, grant access to the resources by taking into account users' functions, implement security policy that controls users' access to particular resources, and centrally register activities related to identity management that are performed on all IT systems that are connected to each other.

Appropriate solutions for protecting sensitive information are used in *Workflow Management Systems* understood as a systems supporting the teamwork. Workflow systems secure, manage document repositories, e.g. control access to each document and provides check-in/check-out controls over their modification. Because a centralized *Document Management System* is backed up on a rigorous (often automated) schedule, the mission-critical information employees store there is protected. In DMS systems there is also a problem of legality of scanned and digital documents which is a topic that may be of particular concern to an organization when the system will contain sensitive corporate information, patents, trademarks, or other documents that might at some time be called into play in a legal setting.

### 6.3.1. Integrated IT systems protecting organizational intellectual property

Some extension for *Workflow systems* are *Document Management Systems* (DMS) used to track and store electronic documents, and related to digital asset management, document imaging, workflow systems and records management systems.

These systems are the most commonly used form of IT support for an organizational knowledge codification strategy; they give one considerable freedom in defining the scope and manner of collecting and managing information contained in stored documents.

*Document Management Systems* commonly provide storage, versioning, metadata, security, indexing of documents as well as retrieval electronic documents from the storage.

*Document Management Systems* are often viewed as a component of *Enterprise Content Management* (ECM) systems, which are more sophisticated and complex systems that provide the functionality of document management, web content management, search and retrieval, collaboration, database records management, *digital asset management* (DAM), workflow management, capture and scanning various documents. ECM is primarily aimed at managing the life-cycle of information from initial publication or creation all the way through archival and eventually disposal. In ECM systems when content is checked in and out, each use generates new metadata about the content, to some extent automatically – information about how and when the content was used can allow the system to gradually acquire new filtering, improve corporate taxonomies and semantic networks. Collaborative ECM systems go much further, and include elements of knowledge management by using information databases and processing methods that are designed to be used simultaneously by multiple users, even when those users are working on the same content item. They make use of knowledge based on skills, resources and background data for joint information processing.

*Document Security Management* systems (DSM), are software programs for managing access to documents. DSM provide mechanisms which allow the author of confidential information to share it with other users without losing control over such information. Among these systems' functions are: preventing disclosure of confidential information, large-scale control of access permissions regarding a document, and recording access.

*Enterprise Rights Management* (ERM)[2] systems, that is, information rights management systems, provide security with regard to documents stored in a company in an electronic form. Their task is to limit access to electronic documents that are subject to different confidentiality restrictions. Digital rights management systems, that is, DRM systems, are a special case of information rights management systems. They are used to protect against unauthorized copying of multimedia documents (pictures, movies, music files, e-books) that are intended to protect multimedia files sold on the market. ERM systems, on the other hand, protect internal and sensitive electronic documents in companies or organizations.

ERM systems use technologies securing data through data encryption, which ensures secure data storage, transmission as well as access to data (it is also said that data are safe "at rest", when they are "in transit" and "in use"). A document is decrypted the moment it is opened by authorized persons or applications having the appropriate cryptographic key. Documents are decrypted in a computer's internal memory for an application which is intended to process the data. This process is usually transparent to the user, and the keys are distributed automatically. If a document is copied outside the authorized system, such a copy will be unreadable without the appropriate software and a cryptographic key.

Moreover, ERM[3] systems define actions that are permitted with respect to particular data, for example, printing, copying to the clipboard, converting data to another format, sending data by e-mail, etc. may be permitted or forbidden. This constitutes the logical protection of electronic documents by means of access rights. This protection is enforced by an application where documents are pro-

2 Sometimes they are also called IRM systems.

3 Leading-edge ERMs are Adobe LiveCycle Rights Management, GigaTrust ERM or Oracle Enterprise Content Management.

cessed or by the operating system (documents in files). Such protection is only effective within a given application or system – authorization rights are no longer valid after a document has been transferred outside the environment that enforces authorization.

In order to comprehensively protect organizational information, *Data Leak Protection* (DLP) solutions[4] are used. They implement a detailed security policy with respect to specially marked data and analyse the content of data in transit, which are most frequently transferred outside a company, based on the appropriate heuristics. These are the most complex IT systems which ensure the protection of intellectual capital in companies and have advanced tools for carrying out the following tasks:

- traffic analysis,
- creating and maintaining security policy,
- monitoring mobile devices and employees through monitoring their actions.

Such solutions may entail monitoring the security policy used for individual positions, but they may also be dedicated to distributed companies or organizations. The most commonly used methods of monitoring data security in *Data Leak Protection* systems entail:

- searching for confidential information by using regular expression,
- scanning databases and searching for as well as matching specific patterns,
- using a fingerprinting technique (creating the so-called document fingerprint),
- adding specific metadata to documents and analysing them,
- analysing passages of documents (characteristic strings),
- behavioural and statistical analysis,
- linguistic analysis (using computational linguistics methods).

Some of the mechanisms presented above are weak when working individually, e.g. searching for confidential information by using regular expressions is prone to high false positive rates and offers very little protection for unstructured content like sensitive intellectual property. Very valuable and sophisticated methods are used in statistical analysis, e.g. by using methods of computational linguistics, machine learning, Bayesian analysis, and other statistical techniques to analyse a corpus of content and find policy violations in content that resembles the protected content. Techniques of linguistic analysis use a combination of dictionaries, rules, and other analyses to protect nebulous content that resembles an completely unstructured ideas that defy simple categorization based on matching known documents, databases, or other registered sources.

[4] DLP are also called *Data Leak Prevention* systems.

Solutions used by some companies make it possible to define the content, context and intended use of data and to manage who can transfer specific information as well as how and where. Doing so allows one to create a detailed data flow policy depending on a particular organization's detailed requirements. Such solutions make it possible to specify where data should be stored in a network as well as to monitor, in real time, who uses these data and how. Some of DLP systems start to differentiate themselves with other advances to help meet particular enterprise needs, including:

1. Automatic identification of files that may contain intellectual property and identify employees with a disproportional amount of intellectual properties in their personal storage locations, email or other locations.
2. Third party integration, from web gateways forensics tools.
3. Full capture for recording all traffic, not just policy violations.
4. Anonymization of policy violations to support international workplace privacy requirements.

Even if an organization uses an advanced DLP solution, it is vulnerable to the leakage of sensitive data through copying or photographing. Given that the majority of data leakages are unintended, it can be assumed that, by using DLP solutions, we can considerably reduce the likelihood of accidental leakage of confidential information.

It should be noted that a policy of strong protection of information resources (in particular those categories of information resources that often contain an organization's sensitive information) sometimes makes it more difficult for an organization to facilitate communication between employees as well as interact with the environment and hinders other customer-oriented activities, e.g. promotional or marketing activities.

While the existing intellectual property regime provides the building some kind of "isolated fortresses of knowledge" for adequate protection of investment in digitally distributable products, businesses and administrations have yet to use these blocks to build the platforms needed to make the approach commercially viable. These platforms will need to include light-weight, internationally harmonized enforcement mechanisms, and commercial and political acceptance of the technical and contractual models needed to support them.

### 6.3.2. Systems protecting non-confidential information outside an organization

The occurrence of intellectual property infringement is constantly on the rise, with corporate and academic resources being particularly under threat. A significant part of corporate information resources is non-confidential and expressed in the form of text and, hence, it cannot be secured by using fingerprinting technologies, as information content itself has intellectual value. In a world that is entirely based on knowledge, intellectual property is contained in various scientific, expert and legal papers. The growing number of incidents connected with the unlawful use of intellectual property is related to increasing access to information. The existing solutions and systems protecting intellectual property searching for borrowings or plagiarisms in specified (suspicious) documents in relation to documents stored in repositories of text documents (public Internet resources or corporate or internal databases). An important attribute of the existing systems is their ability to properly determine borrowings/plagiarisms in relation to the real number and rate of borrowings. A high level of system precision here means a small number of false positives, whereas a high level of system recall means that it detects the majority of borrowings/plagiarisms in an analysed set of documents.

Advanced IT systems protecting intellectual property contained in public text information resources should use conceptual knowledge representation as well as methods and mechanisms causing parts of the text of documents which are expressed in a different way but which have the same information value in semantic terms to be understood as identical or at least very similar.

The most important principle of this system is that it will carry out a variety of tasks aimed at protecting intellectual property. A basic task of the system is to determine whether a given text document contains borrowings from other documents (both those stored in a local text document repository and on the Internet).

Detection of borrowings comprises local similarity analysis [Charikar, 2002], text similarity analysis and global similarity analysis [Stein et al., 2010]. Global similarity analysis uses methods based on citation similarity as well as stylometry, that is, a method determining a work's authorship of analysing the statistical characteristics of an author's style.

Another task of the system is based on a different business model and is aimed at protecting documents assigned to the system. This is important for the great number of authors of articles and papers as well as documentation who place their works among publicly accessible information resources and whose works are valuable enough to be protected. Such articles are often subsequently copied in whole or in part in violation of copyright laws. Therefore, the system's task is to periodically check global resources for documents that would be similar enough to those protected by the system for copyright infringement so as to be deemed undeniable. For this purpose the system should be equipped with a downloader equipped with heuristics that download such documents from the Internet that are thematically similar to protected documents; after downloading they are placed in a repository kept by the system and then analysed for their similarity to the protected documents with regard to long concept sequences (performed by a classifier).

The system's functioning is described in detail in [Ceglarek, 2013]. This system uses a semantic network and follows the so-called text-refinement procedure which is characteristic of the processing of text documents. As part of this procedure it also uses mechanisms such as: text segmentation, morphological analysis, eliminating words that do not carry information, identifying multi-word concepts, disambiguating, and using semantic compression. Concept disambiguation entails indicating the appropriate meaning for ambiguous concepts. The system employs a concept disambiguation mechanism and of semantic compression mechanism [Ceglarek, 2014], which entails replacing concepts with more general ones with minimized information loss.

When carrying out their tasks, systems protecting intellectual property process enormous amounts of information. This is why the way in which documents in repositories are indexed as well as the algorithms that are used to establish the similarity between compared documents with regard to long, common sentences/phrases constitute a key factor behind these systems' efficiency.

## 6.4. Measuring the costs of information breaches

Information security expenditures are increasingly growing. To protect the confidentiality, integrity, and availability of information, while assuring authenticity and non repudiation, organizations are investing large sums of money in information security activities. Since security investments are competing for funds that could be used elsewhere, it's not surprising that managers are demanding a rational economic approach to such expenditures.

An organization's expenditure on intellectual property protection tools is reasonable and well calculated only if one can determine the value of losses (costs) incurred due to security breaches. Consequently, the money spend on a security control should not exceed the value of the information assets the security control protects.

Annual reports of IBM [www.ibm.com/services/security], which monitors security breaches show that incidents cause negative financial consequences in following 6 categories: reputation and brand damage (29% in 2013), lost productivity (21%), lost revenue (19%), forensics (12%), technical support (10%) and compliance regulatory (8%).

Reports evaluating losses that result from information security breaches or, broadly speaking, from security breaches related to intellectual capital, which are drawn up by various institutions and specialized research centers, are based on different methods for estimating losses. Therefore, if one wants to determine the extent of losses incurred due to infringement of intellectual property rights, it is necessary to establish, as far as possible, universal categories of losses sustained by an organization as a result of such infringement.

The real cost of a security breach is multi-faceted and difficult to quantify. The loss can be direct or indirect. The business impact of a security breach can be classified into the following categories [ISF Report, 2005]:

- Financial impact: loss of sales and loss orders or contracts, loss of tangible assets, penalties/legal liabilities, unforeseen costs, depressed share price;
- Operational impact: loss of management control, loss of competitiveness, new ventures held up, breach of operating standards;
- Customer-related impact: delayed deliveries to customers or clients, loss of customers or clients, loss of confidence by key institutions, damage to reputation;
- Employee-related impact: reduction in staff morale/productivity, injury or death.

The above mentioned impacts can be tangible and intangible. It is possible to estimate some of the above costs such as lost of sales and reduction of productivity. Other costs such as damage to reputation are intangible and difficult to estimate. Nonetheless these costs are extremely important to measure the true cost of necessary security expenditures for an organization, and therefore some researcher propose to capture the implicit costs through the loss of market capitalization a publicly traded firm may experience. Some researchers propose a market valuation-based approach to estimate the true cost of security breaches [Cavusoglu, 2004]. There approach is based on efficient market hypothesis on which, investors are believed to revise their expectations based on new information in announcements. Investors' expectations are reflected in the value of the firm. Security problems may signal to the market a poor security practices within the firm leading investors to question the long-term performance of the firm.

A security breach may be perceived by investors as a factor that might cause both short-term and long-term losses and reduce the expected future cash flow. Thus, the measurement of changes in a company's market value after a security breach has been announced can help evaluate the costs of this breach.

Organizations can't fully quantify the loss if they have not valued the resource. Valuing information for this purpose differs significantly from valuing information for accounting purposes. In most cases, the organization is not trying to sell its data to others and has not established a marketplace in which the data's value could be tested.

In order to properly estimate the value of an organization's information assets for risk purposes, one should take into account the influence of the following factors [Poore, 2000]:

- Exclusive possession: The degree to which information is exclusively possessed directly relates to the value the information has to the organization that possesses it.
- Cost of creation or re-creation. Determine how much it cost the enterprise to create or to acquire the information in the first place.
- Utility: Information that is useful is at least as valuable as the use to which it can be put.
- Liability. When information represents a relationship of trust, then the possessor of the information may assume liability for its protection.
- Convertibility. When information represents value intrinsically, or when information has intrinsic value, (e.g., intellectual property) potentially convertible to other assets, the information valuation would be at least equal to the conversion value.
- Operational impact. An organization can often assign value on the basis of the impact the absence of the data would have on the organization or the impact that incorrect or untimely date have on the organization.

The most popular among the many different methods that were developed for the purpose of evaluating an organization's information assets are financial calculations used by firms in decision making include ROI (Return of Investment), ROSI (Return of Security Investment), and cost-benefit. Some approach look at the costs of creating/recreating the compromised assets, others examine costs incurred as a result of the security breach, while still others try to capture all effects on both revenues and costs [Brotby, 2009].

## Conclusion

This paper presents a review of tools and mechanisms that are used both to protect an organization's intellectual property from falling into the wrong hands and to protect an organization's publicly accessible resources against misuse.

Protecting a corporation from information leakage, violation or other intellectual property infringements requires the use of comprehensive security systems that are equipped with security modules aimed at protecting corporate knowledge resources.

Three categories of systems can be identified among IT tools and systems that protect an organization's information assets. The first category encompasses systems that were developed in order to support the creation, transfer or dissemination of an organization's information resources and that ensure security in this respect (e.g. CMS). The second category includes systems that were created for the purpose of protecting information resources with regard to selected security aspects (e.g. Identity & Access Management systems). The third category comprises those systems that are aimed to comprehensively protect an organization's information resources.(e.g. DLP systems).

Choosing the right system for an organization is closely related to and depends on the organizational business model. Depending on the organizational requirements, appropriate mechanisms and information technologies should be selected which will make it possible to implement proper security policies and match them to the requirements of a given organization.

The elements of intellectual capital that are connected with non-confidential knowledge (which is usually recorded in the form of unstructured text documents) must be monitored within the Internet's global information network by using IT systems. In order to increase their effectiveness, artificial intelligence mechanisms are used in these systems more and more frequently as well as natural language processing methods and tools. The systems process information by using knowledge representation structures that are increasingly semantically richer. The choice of IT tools and a company's expenditure on intellectual property protection tools should depend on the amount of losses incurred due to infringements of intellectual property rights. Methods for estimating losses are inextricably linked with methods for evaluating an organization's information assets, and the valuation of assets in the context of risk management depends on implicit factors.

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Chapter 7
# Comparative analysis of business processes notation understandability

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## Introduction

The purpose of this paper is to present a solution for measuring the understandability of selected business process modelling notations and their practical application based on empirical tests of notation comprehension. The solution design was based on an overview of the literature of the subject and tested on a sample of 113 respondents, experienced and inexperienced in business process modelling. Both the subjective and objective understanding of the processes evaluation was based on process models and written use-case. Three notations used for modelling business processes were diagnosed: EPC, BPMS and BPMN.

The comparative analysis of business process understandability was performed using comprehension tests and an ANOVA test which allowed the evaluation of differences between the groups of respondents, experienced and inexperienced in business processes modelling. The findings will be a basis for formulating recommendations with respect to notations to be chosen for projects where process modelling is aimed at supporting human understanding and communication, and where unambiguous understanding of models is the key criterion for selecting the Business Process Modelling Technique (BPMT). The analysis of differences in understanding modelling notations may be helpful when testing the process-related competence of people participating in projects where process modelling and understanding is required. It may also improve the process of communication between individuals with various professional profiles and translate into a higher efficiency of changes implemented in organisations.

## 7.1. Business process models – an overview

### 7.1.1. The role of business process modelling

The changes in the business environment are causing growing interest and a continual development of process approach, its concept, methods, and IT tools enabling Business Process Modelling (BPM) and improvements intended to enhance an organisations' performance. BPM can be defined as a process of documenting business processes through a combination of text and graphic notation [Krcmar, Schwarzer, 1994, p. 14–15]. BPM is a key element in organisational change management and has many and varied applications, not solely limited to projects intended to develop a process-oriented organisation. Other important areas of the business process model application include the arrangements preceding the selection or development of an IT system supporting business management (adjusting the system to the organisation needs, usage a common language for IT engineers and business analytics), designing workflow systems, documenting processes in the implementation of quality management systems, and process benchmarking or Activity Based Management [Rosemann et al., 2005, p. 45–57].

The scope and purpose of model usage in an organisation's projects reflect a different approach to business process modelling, including modelling language, level of detail, abstraction level and project complexity [Pinggera et al., p. 21–22]. Ould [1995] and Curtis et al. [1992] argue that BPM is especially useful in three business goals:

– describing a process for a different end-user (human, machine)
– analising and assessing the properties of a process
– enacting a process for simulation

Process Modelling Languages (PML) differ in the way they reflect business reality. PML may present one or more different perspectives of business process and organisation. Curtis et al. [1992, p. 77] identified four perspectives:

– functional (functional dependencies between activities/tasks, flows of informational data, artefacts, products),
– behavioural (sequencing, complex decision-making conditions, entry and exit criteria),
– organisational (where and by whom in the organisation process tasks are performed),
– informational (entities, e.g. data, artefacts, products, objects producing or manipulated by a process).

Depending on the modelling perspective adopted in the organisation's project and their purpose and scope, different techniques (languages) may be appropriate [Giaglis, 2011, p. 213; Kunze et al., 2011, p. 45–56]. Faced with various types of Business Process Modelling Technique (BPMT) process designers require a set of criteria to determine the most suitable notation to meet their needs and design perspective. Taking into account one of the basic goals of process modelling, i.e., supporting human understanding and communication, the key criterion for selection of BPMT is a high comprehension of models.

### 7.1.2. Measuring the understandability of business process models

The general semiotic framework for defining the quality of models proposed by Lindland et al. [1994] assumed that a model is built in some notation (*syntactic* quality), represents a domain (*semantic* quality), and has some audience (*pragmatic* quality). Taking into account the basic purpose of business process modelling, the pragmatic aspects of model quality should determine the choice of adequate Business Process Modelling Technique (BPMT) [Aalst et al., 2012, p. 191].

Pragmatic model quality (PMQ) is understood as the comprehension of process model [Soffer et al., 2012, p. 357–365]. Understandability is the ability to design process model in the chosen BPMT easily understood by its users. A graphical representation of a process using this BPMT is clear. Figl and Laue [2011, p. 453] defined understandability of business process models as follows: "A person understands a BPM when they are able to explain the BPM, its structure, its behaviour, its effects on its operational context, and its relationships to its application domain in terms that are qualitatively different from the tokens used to construct the BPM in a modeling language."

PMQ depends on many model properties that impact the ease of creation, comprehension, and modification, such as visual appearance (e.g. meaningful icons, diagram layout), and closeness of mapping domain [Lindland et al., 1994, p. 45–48]. Pragmatic approach should prompt one to select an appropriate modelling notation which will [Becker et al., 2000; Rosemann et al., 2005, p. 45–57; Scheer, 1998; Scholz, Vrohlings, 1994]:

- allow the necessary elements defining the process to be described at a given level of detail,
- contain graphic symbols and associated semantic rules comprehensible to all concerned, including the inexperienced employees as well as professionals,
- facilitate communication between employees from different business domains,
- enable the processes to be systemised logically and graphically within a framework concept, a not insignificant factor, as the models will be read and analysed by individuals who did not participate in the modelling directly.

BPMT should allow for designing models that can be used as a basis for communication between users with different profiles (eg. business vs. workflow analysts). Furthermore, the notation should intuitive, be easy to comprehend, and should ensure interpretational flexibility of the model [Recker, Mendling, 2007, p. 235–244]. Therefore, selecting a notation gains significance in the context of the modelling objective and planned application of the business process model.

The common measure of understandability is based on interviews with users of process models. Research questionnaires used to assess understanding of process model include questions related to the order, concurrency, and exclusivity

[Laue, Gadatsch, 2011, p. 39]. In Table 7.1 different approaches to measuring understandability are presented.

Table 7.1. Measuring of understandability – an overview of empirical works

| Authors | Measuring understandability |
|---|---|
| Sarshar & Loos | Number of correct answers to process related questions in the questionnaire |
| Mendling et al. | Correctly answered questions about model |
| Recker et al. | Correctly answered multiple choice questions about model and number of correctly filled blanks in a cloze test |
| De Lucia et al. | Five multiple choice questions (comprehension level: harmonic mean of aggregated recall and precision of answers) |
| Bavota et al. | Precision and recall concerning correctly answered multiple choice questions out of 10 (one or more correct answers per question) |

Source: [Sarshar, Loos, 2005; Mendling et al., 2007; Recker et al., 2007; De Lucia et al., 2008; Bavota et al., 2011].

Mendling et al. [2007], based on extensive literature studies, also indicated key technical factors that might influence understandability of process models, e.g. model characteristics (number and type of splits) and visual layouts. In addition, the authors show that the assessment of the understandability of the model should consider the knowledge about the domain being described in the model and semantic comparability of analysed models.

## 7.2. Diagnosis of understandability of process model

### 7.2.1. Research design and methodology

The analysis covered business process modelling notations based on an activity diagram and presenting a formal description of the process, with events and agents performing the activities addressed: Event-Driven Process Chain (EPC), Business Process Management System (BPMS) and Business Process Model and Notation (BPMN).

EPC is a modelling language used to describe business processes and workflows [Keller et al., 1992]. This method was developed within the framework of Architecture of Integrated Information Systems (ARIS) in order to model business processes. EPC consists of three basic objects: events, functions and connectors (logical AND, logical exclusive OR XOR and logical OR). According to EPC Modelling, the assumption model consists of sequences of events triggering functions included in the business process. In terms of practical use, EPC is one of the most widely used BPMT supported by SAP. It is classified as traditional process modelling language [Mili et al., 2010, p. 10–18].

BPMS is a framework for process management supporting a continuous process and total organisational improvement. The main idea of BPMS is to represent the dependencies between the core elements of an organisation: business process, product, organisational units, and information technology, and to make them controllable. According to BPMS approach, modelling is done using the so-called model types which can be understood as "templates" for modelling processes, organisation units, roles, documents, etc [BOC, 2006].

BPMN is standard for process modelling. Currently it is maintained by the Object Management Group (OMG). According to their definition, BPMN is a graphical representation for specifying business processes in a business process model [OMG, 2011, p. 1–12]. This notation allows both business modelling (basic level) and technical execution of processes (advanced level). At the basic level of complexity a model visually represents a business process flow (descriptive modelling). At the second level, the model gives possibility either to analyse the process performance using simulation tools or to create requirements for IT solutions (analytical modelling). The model complexity at the third level may deliver an executable code implemented as an application (executable modelling).

BPMN belongs to dynamic process modelling languages [Mili et al., 2010, p. 10–11]. The main properties of process models analysed in the experiment are presented in the Table 7.2.

**Table 7.2.** The analysed Business Process Modelling Techniques

| BPMT | Events, control objects | Gateways | Organization units |
|---|---|---|---|
| Event-driven Process Chains (EPC) | Start event<br>Intermediate events<br>End event | AND<br>OR<br>XOR | Business role symbol |
| Business Process Management System (BPMS) | Start event<br>Process start<br>Process end<br>Cross reference | Decision<br>Parallelism<br>Merging | Business role (defined within activity) |
| Business Process Model and Notation (BPMN) | Start event<br>Message event<br>End event | AND<br>OR<br>XOR | Poll<br>Lane |

Source: Own elaboration.

This is an unprecedented selection – the three notations not having been analysed before for their comprehension in terms of any of these criteria in such a combination as this.

The notations selected have been used for modelling a process titled *"Processing a freight forwarding order"*. The structure of this process is compatible with a generic model of a processing a freight order. The level of complexity and logic of the process does not require the respondents' expertise in the domain knowledge. This modelling was performed by means of IT process modelling tools selected for the study (Aris, Adonis), while the survey among respondents was conducted without indicating nor using these tools. The characteristic of the analysed model is given in the Table 7.3.

**Table 7.3.** Characteristic of process model

| BPMT | Numbers of diagram features | | Number of diagram objects, paths | | | | |
|---|---|---|---|---|---|---|---|
| | Shapes | Colours | Activities | Parallel splits | Exclusive choice | Merges | Loops |
| EPC | 5 | 4 | 10 | 3 | 2 | 2 | 1 |
| BPMS | 7 | 4 | | | | | |
| BPMN | 3 | 3 | | | | | |

Source: Own elaboration.

The article is based on an analysis of diversity of Business Process Modelling Techniques (EPC, BPMS, BPMN) understanding, based on a survey of individuals experienced (EXP) and inexperienced (IEXP) in business process modelling. The exercise included an attempt to verify a hypothesis that the diversity of notation understanding depends on the level of business process modelling experience. In particular, the following hypothesis will be verified using ANOVA single factor analysis:

Hypothesis: The understanding of Business Process Modelling Techniques in respect of each individual notation analysed (EPC, BPMS, BPMN), as well as for the total of BPMTs analysed is more diverse between the groups experienced in business process modelling (EXP) and the groups inexperienced in business process modelling (INEXP) than within these groups.

Significant differences in the subjective perception of notation understanding between both groups (EXP and INEXP) as well as within these groups should be shown by the ANOVA test. ANOVA is a statistical test used for comparing mean values in groups. The total variance (diversity of results) is divided into a part deriving from differences between groups and a part deriving from differences between results within the groups.

An assumption was made that persons experienced in business process modelling would make less mistakes in the comprehension tests performed for each of the notations included in the exercise than those inexperienced in business process modelling. Hence, the degree of understanding the business process models in the BMPTs covered by the tests would be higher in the group of experienced respondents (EXP) than in the group of respondents inexperienced (INEXP) in business process modelling.

The data was collected from 28th February to 7th March 2015 through a questionnaire-based survey of information technology students, business administration students and practitioners declaring experience in business process modelling.

The principal part of the survey focussed on the respondents' perceived (subjective) and verified (objective) understanding of the business process modelling notations. The survey included two main tests of BPMT comprehension. The general test of notation comprehension (Test 1) enabled the subjective assessment of understanding the business process flow and contents based on the model and a verification test. The detailed test of notation comprehension (Test 2) enabled subjective assessment of understanding a process fragment, with a particular focus on understanding logic gates. Furthermore, the detailed test included a verification component, which enabled objective assessment of respondents' understanding of the notation.

The business process modelling notation ease of understanding indicator was defined – for both Test 1 and Test 2 – as a ratio of the number of all respondents who answered the questions verifying the subjective perception of notation *x* correctly to the number of all respondents who perceived notation *x* as comprehensible. The indicator is a synthetic representation of the notation comprehension, while allowing a comparison of analysis results for all notations covered by the exercise.

In order to distinguish the groups of respondents and to characterise them, they were asked to specify their experience in business process modelling, the areas of process modelling application and the faculty they graduated from or currently attend.

### 7.2.2. Sample characteristics

The modelling notation comprehension test was conducted on a sample of 133 respondents: 40 of them (30.1%) declared to have had experience in business process modelling; 93 (69.9%) declared that they had no experience at all in business process modelling. Those experienced specified the areas of modelling application: 53% of respondents learned modelling notations at the university classes; 38% modelled business processes when participating in projects intended to improve the performance of their organisation, 35% – when performing IT system pre-deployment analyses, 30% – prior to selecting an IT system; 18% of respondents gained their experience when modelling processes for the personnel training purpose, 10% – when preparing their organisation for ISO certification and 5% – when developing an operational risk management system; 50% of the respondents declared experience in more than one area of process modelling application; 95% of those who declared having gained experience at the university were IT/engineering students and only 5% studied economics / business administration.

## 7.3. Results of the empirical survey

In order to verify the research hypothesis, the notation comprehension factor was analysed and an ANOVA simple factor analysis conducted to investigate the significance of differences in respondents' average answers. The analyses were performed for Test 1, Test 2, the total of BMPTs and for each of the three modelling notations, in the following respondent groups: experienced in business process modelling (EXP) and inexperienced in business process modelling (INEXP).

In the business process modelling notation comprehension test for the total of BMPT (Table 7.4), the notation ease of understanding indicator is highest in the group of experienced respondents, both in Test 1 (84.8% in the EXP group and 82.7% in the INEXP group) and in Test 2 (52% in the EXP group and 45.4% in the INEXP group). Due to its structure, the notation ease of understanding indicator is identified with the average. ANOVA shows that there is no significant diversity between the respondent groups as far as understanding BPMT is concerned. The means square between groups is definitely higher for Test 2 than for Test 1, supporting the assumptions made when constructing both tests. The detailed comprehension test (Test 2) turned out to be more difficult for both respondent groups and provided a stronger verification of the notation comprehension. The outcome shows that the respondents experienced in business process modelling solved the more difficult test slightly better than those inexperienced.

**Table 7.4.** Differences in mean significance of BPMT understanding between and within groups by comprehension tests

<table>
<tr><th colspan="2"></th><th colspan="2">EXP</th><th colspan="2">INEXP</th></tr>
<tr><td rowspan="4">BPMT total<br>Test 1</td><td>average</td><td colspan="2">0.8485</td><td colspan="2">0.8274</td></tr>
<tr><td>variance</td><td colspan="2">0.1299</td><td colspan="2">0.1434</td></tr>
<tr><td rowspan="2">ANOVA</td><td>$MS_B$</td><td>$MS_W$</td><td>test F</td><td>p-value</td></tr>
<tr><td>0.0305</td><td>0.1393</td><td>3.8704</td><td>0.640*</td></tr>
<tr><td rowspan="4">BPMT total<br>Test 2</td><td>average</td><td colspan="2">0.5208</td><td colspan="2">0.4549</td></tr>
<tr><td>variance</td><td colspan="2">0.2522</td><td colspan="2">0.2491</td></tr>
<tr><td rowspan="2">ANOVA</td><td>$MS_B$</td><td>$MS_W$</td><td>test F</td><td>p-value</td></tr>
<tr><td>0.2908</td><td>0.2500</td><td>3.8710</td><td>0.282</td></tr>
</table>

* difference of means is not significant ($p<0.05$); $MS_B$ –Mean Square Between groups; $MS_W$ – Mean Square Within groups

Source: Own elaboration.

The single factor ANOVA was also performed for the three notations chosen for the exercise: EPC, BPMS and BPMN. In each of them, both the experienced and inexperienced respondents made definitely less mistakes in Test 1 than in Test 2. The means square between groups is also definitely higher for Test 2 than for Test 1 for each of the notations, which confirms the greater difficulty of Test 2, and greater diversity of notation comprehension between EXP and INEXP than within these groups. For each notation, ANOVA shows that there is no significant diversity between the respondent groups as far as notation understanding is concerned – the difference of means is $p<0.05$. Tables 7.5–7.7 summarise the analyses of notation comprehension for both respondent groups.

**Table 7.5.** Differences in mean significance of EPC understanding between and within groups by comprehension tests

| **Tests** | | **EXP** | | **INEXP** | |
|---|---|---|---|---|---|
| **EPC** Test 1 | average | 0.8214 | | 0.8484 | |
| | variance | 0.1521 | | 0.1305 | |
| | **ANOVA** | **$MS_B$** | **$MS_W$** | **test F** | **p-value** |
| | | 0.0143 | 0.1368 | 3.9445 | 0.746* |
| **EPC** Test 2 | average | 0.4286 | | 0.3286 | |
| | variance | 0.2540 | | 0.2238 | |
| | **ANOVA** | **$MS_B$** | **$MS_W$** | **test F** | **p-value** |
| | | 0.2000 | 0.2323 | 3.9402 | 0.356* |

* difference of means is not significant ($p<0.05$); $MS_B$ –Mean Square Between groups; $MS_W$ – Mean Square Within groups

Source: Own elaboration.

The EPC notation (Table 7.5) was slightly more comprehensible (84.8%) for the inexperienced group, but only in Test 1. The difference in percentage points between Test 1 and Test 2 is greatest for EPC, which may indicate that logical operators of this notation are the most difficult to understand. ANOVA in Test 2 for the EPC technique shows the greatest diversity between the respondent groups (EXP and INEXP) – *p* value = 0.356.

**Table 7.6.** Differences in mean significance of BPMS understanding between and within groups by comprehension tests

| **Tests** | | **EXP** | | **INEXP** | |
|---|---|---|---|---|---|
| **BPMS** Test 1 | average | 0.9429 | | 0.8941 | |
| | variance | 0.0555 | | 0.0958 | |
| | **ANOVA** | **$MS_B$** | **$MS_W$** | **test F** | **p-value** |
| | | 0.0589 | 0.0842 | 3.9215 | 0.405* |
| **BPMS** Test 2 | average | 0.5882 | | 0.5714 | |
| | variance | 0.2495 | | 0.2478 | |
| | **ANOVA** | **$MS_B$** | **$MS_W$** | **test F** | **p-value** |
| | | 0.0068 | 0.2483 | 3.9229 | 0.869* |

* difference of means is not significant ($p<0.05$); $MS_B$ –Mean Square Between groups; $MS_W$ – Mean Square Within groups

Source: Own elaboration.

In the BPMS notation analysis (Table 7.6), the differences between the ease of understanding indicator values expressed in as a percentage are insignificant for groups of respondents experienced and inexperienced in business process modelling, both in Test 1 and Test 2. BPMS shows the highest understanding indicators, most likely owing to its "business", intuitive nature, and due to the fact that it is suitable for demonstrative and analytical modelling rather than the specification of executable processes.

**Table** 7.7. Differences in mean significance of BPMN understanding between and within groups by comprehension tests

<table>
<tr><th colspan="2">Tests</th><th colspan="2">EXP</th><th colspan="2">INEXP</th></tr>
<tr><td rowspan="4">BPMN<br>Test 1</td><td>average</td><td colspan="2">0.7778</td><td colspan="2">0.7333</td></tr>
<tr><td>variance</td><td colspan="2">0.1778</td><td colspan="2">0.1982</td></tr>
<tr><td rowspan="2">ANOVA</td><td>$MS_B$</td><td>$MS_W$</td><td>test F</td><td>p-value</td></tr>
<tr><td>0.0480</td><td>0.1916</td><td>3.9282</td><td>0.618*</td></tr>
<tr><td rowspan="4">BPMN<br>Test 2</td><td>average</td><td colspan="2">0.5294</td><td colspan="2">0.4411</td></tr>
<tr><td>variance</td><td colspan="2">0.2567</td><td colspan="2">0.2502</td></tr>
<tr><td rowspan="2">ANOVA</td><td>$MS_B$</td><td>$MS_W$</td><td>test F</td><td>p-value</td></tr>
<tr><td>0.1765</td><td>0.2524</td><td>3.9361</td><td>0.405*</td></tr>
</table>

* difference of means is not significant ($p<0.05$); $MS_B$ –Mean Square Between groups; $MS_W$ – Mean Square Within groups

Source: Own elaboration.

In case of BPMN (Table 7.7), the difference between indicators in Test 1 and Test 2 is smallest, which may be owing the fact that logical operators are presented in a more comprehensible form here than in other notations, but only if the general description of the process was comprehensible. ANOVA shows that there is no significant diversity of model understanding between both respondent groups.

## Conclusion

In summary, the results of ANOVA in the tests of business process modelling notation understanding conducted for BMPT in general, as well as for each notation separately, show that there are no significant differences in understanding BMPT between the groups of respondents experienced and inexperienced in business process modelling. The findings do not support the research hypothesis that persons experienced in business process modelling should – namely owing to their project experience and skills – differ significantly in terms of understanding the notations from those having no such experience.

The analysis allows a conclusion that the ability of understanding the three modelling notations demonstrated by the respondents who declared practical experience in process modelling does not differ much from that demonstrated by individuals who had no contact with process modelling at all. Such a diagnosis may be regarded as evidence of the insufficient competence of people involved in projects aimed at: improving an organisation's operations (38% of the EXP group), analysing an IT system prior to its deployment (35% of EXP), selecting an IT system for an organisation (30% of EXP), training the personnel (18%) or documenting an organisation's processes for the purpose of ISO certification (10% of EXP). Furthermore, the business process modelling programmes seem to be ineffective, considering that 53% of the respondents declared that they gained their modelling experience at university.

The analysis proves that BPMS notation is the most comprehensible one and may be recommended for organisations where the business process modelling requires all employees to be engaged, their process awareness built and the process-oriented world to be introduced to them in the course of personnel training, for example. The understanding of process models may enhance the commitment of an organisation's employees, reduce resistance to change and improve effectiveness of projects.

The focus of our future research will be on other aspects of diagnosing the notations informational potential and on adding other groups of notation users to the research sample.

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Chapter 8

# The flow of funds generated by crowdfunding systems

*Dariusz T. Dziuba*

## Introduction

The purpose of this paper is to estimate the scale and the main trends in one of the electronic market segments – the Internet crowdfunding. The study is based on a set of at least 1444 active electronic platforms selected by the author, among which systems publicizing their statistics (trustworthy) were identified[1]. This subset of data (499 systems) was used as a basis for estimating the size of the crowdfunding segment as of 27th February 2015. The aggregate value of funds (more broadly: capital) raised by individual systems, as well as by the whole segment of the market was used as a measure. As a result, answers to the following questions were found:

– what is the size of the market segment under investigation, both global and analysed in a breakdown by individual crowdfunding models,
– how is the global value structured,
– what are the dynamics of the segment growth, should one take two points of time into consideration? The results obtained were referred to those obtained by the author in his previous study [Dziuba, 2014; 2015] reflecting the situation as of 5th June 2014,
– what tendencies can be observed on the on-line crowdfunding market?

Further on, the following problems are discussed: the essence of the crowdfunding concept, the methods of defining and basic functions; business models; the methodology of separating the crowdfunding segment of the market, the findings as of 27th February 2015 and as compared with previous results; value streams per countries (geographic areas); statistics of exemplary electronic platforms. The conclusion of the paper recapitulates the findings.

[1] For organizational reasons, we shall not present the primary set of electronic platforms here (referring the Reader to the author's publication [Dziuba, 2014]), or any intermediate sets either.

## 8.1. The essence of crowdfunding

The question about the essence of crowdfunding can be generally answered that it is a method of raising monetary contributions. The concept has been existent for a long time and in crowdfunding via the Internet which is analysed here, the World Wide Web with its social media is the medium used for raising funds.

The literature of the subject offers a number of definitions of crowdfunding, although they all converge in meaning. For example:

– the process of soliciting financial contributions from a large group of individuals, to raise funds [Greenberg et al., 2013, p. 2],
– the financing of a project or a venture by a group of individuals ("the crowd"); funds are typically raised on the Internet through relatively small contributions from a large number of people [Bradford, 2012, p. 1],
– "the act of soliciting, via an open call, resources from a wide variety of contributors in order to realize a new idea" [Wash, 2013, p. 631–632].

The definitions quoted above vary in the level of specificity, while emphasizing different areas of crowdfunding application and different models of operation.

Broadly, (on-line) crowdfunding is interpreted as an almost arbitrary form of raising funds via a computer network (the Internet) or via social media (these days, many such systems are available exclusively in social media). A narrower definition however [Burkett, 2011, p. 66] emphasizes the process of participation in a joint undertaking, where e.g. artists, entrepreneurs raise money for their projects, ventures or organizations by gaining support of many individuals ("the crowd"), who collectively contribute money to such projects, venture etc. or invest in them.

Hence, let us formulate the following general definition of on-line crowdfunding [Dziuba, 2012, p. 85–86]:

– it is a process occurring in the Internet environment, activated by an open call presenting an offer (undertaking), where free funds are solicited from a potentially great number of dispersed participants ("the crowd"),
– funds can be contributed in the form of a donation (for charity), a payment made for a material reward to be received in return, for the future access to a lending facility, or – as in case of investment systems – as an investment in some pre-defined venture expected to yield a financial gratification or a profit share,
– the extent of benefits follows from the crowdfunding business model applied and the participant rewarding strategy adopted.

Fundraising is a basic purpose of crowdfunding. But not the only one. This is also a method for capturing valuable market information, such as demand for certain good. Examples include pre-order systems, where the Internet crowd subscribes a certain type of goods (books, for example) or participates in organization of music concerts, etc.; when sufficient funds are collected, the production is launched, the concert is organized, etc. and the sponsor is rewarded with a pre-ordered book copy, a product, tickets for the concert, etc.

## 8.2. Crowdfunding business models

In practice, crowdfunding is a conglomerate of various models of operation, therefore the following have been chosen for the purpose of this study[2]:

1) a non-reward donation model, also referred to as a charity model,
2) a reward-based donation model, also referred to as a sponsorship model,
3) a lending-based model, offering social /business lending,
4) a microfinance-based model,
5) an investment-based model,
6) a hybrid model, also referred to as a mixed model.

Ad 1. In the non-reward donation model funds are raised for a pre-defined purpose of a charity campaign. Internet philanthropists do not expect any reward for their support. Examples of such platforms include: JustGiving.com, FirstGiving.com, etc.

Ad 2. The reward-based donation model focuses on supporting creative projects or individuals as a rule. This is how such platforms as Kickstarter.com, Indiegogo.com, Musicraiser.com, FundRazr.com, etc. work. The crowd of internet sponsors contributes its funds to a project (e.g. music recording, film production, etc.), willing to provide support. The fundraising process is strictly limited in time and involves various donor rewarding strategies (these strategies shall not be the subject of our consideration here). In exchange for their generosity, donors are rewarded with material items (e.g. DVDs, T-shirts, tickets for artistic events, etc.) or non-material items. For the sake of simplicity, pre-sale (pre-order) systems, such as Picatic.com for example, have been included in this model.

Ad 3. The lending-based model is designed as a direct lending facility bypassing traditional financial institutions (banks). This may include both social lending schemes, as well as higher value business-dedicated loans. Examples include LendingClub.com, Lendinvest.com, NationalFamilyMortgage.com, Prospe-r.com, SoFi.com, Zopa.com.

Ad 4. The next crowdfunding model is the microfinance-based one. Its purpose is to provide financial assistance, to those most needy, offered in small sums

[2] A modification of the model typology proposed by the Author in [Dziuba, 2012].

collected and distributed via non-profit platforms, such as Kiva.org, GrameenAmerica.org, or Zidisha.org.

Ad 5. In the investment-based model, the "crowd" of investors commit their free funds (capital) in business ventures (e.g. in start-ups or companies at an early stage of development). This model has evolved into several variants, e.g. collective investment schemes, investment funds or investments in shares or stocks (equity-based crowdfunding, securities models). Examples include EquityNet.com, ASSOB.com.au, Crowdcube.com.

Ad 6. The hybrid model integrates at least two of the above-listed solutions – SellaBand.de, or Polish Beesfund.com can be given as examples here[3].

## 8.3. Crowdfunding segment – the method of separation

Initially, a set of more than 1444 active, i.e. operating crowdfunding platforms was identified and divided into proposed categories (according to the pre-defined model typology). These data were sourced from the Internet, including the accessible catalogues and systems.

A group of crowdfunding systems for which statistics as of 5$^{th}$ June 2014 were captured was used as a starting point for analyses. The group consisted of 523 systems (i.e. some 36% of the original set), including: 112 charity-based platforms, 231 sponsorship-based (including pre-order systems), 52 social/business lending schemes, 26 micro-financing platforms, 83 investment systems and 18 hybrid systems.

This data set was verified in the final tests as of 27$^{th}$ February 2015. In the course of analysis, inactive platforms that had not been in operation (regardless the reason, including e.g. domain expiration) were rejected[4]. Hense, 499 electronic platforms were used as a research sample in the study. For organizational reasons, they are not listed here and neither is the original set of systems.

This subset was used as a basis for estimating the size of the crowdfunding segment, with the aggregate value of funds generated by individual systems, as well as by the whole segment of the market used as the estimation measure. The "aggregate value" term means that it consists of the funds solicited by crowdfunding platforms since the moment of implementation.

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3 The present paper does not cover the so-called system aggregators – intermediate facilities where funds for other electronic platforms are accumulated. They do not generate any value themselves.

4 A group of 24 systems was eliminated, including: 6 donation-based, 8 investment-based, 2 lending-based and 8 sponsorship-based, while several solutions were qualified to other models due to the fact that they changed their operating mode over time.

The platforms accepted for the analysis were grouped by operational models, according to the typology explained earlier in this paper.

## 8.4. The findings

Globally, the segment of crowdfunding generates significant values. As of 27.02.2015, the aggregate capital in excess of USD 52.5 billion (52 557.486 million) has been raised by this method. The figures are summarized in Table 8.1.

Over the period of eight months (since the date of previous test, i.e. 5th June 2014), the size of this market increased significantly, by USD 15.5 billion, i.e. by 42%. Hence, this is one of the most dynamically growing segment of the electronic market.

The major part of this value stream consists of "traditional" crowdfunding systems, i.e. based on non-reward donations (currently this is 44.4%). The social lending model accounts for an insignificantly lower share of the global payments value (41.2%), with business and mortgage loans playing the main role. The very similar model – micro-financing – represents some 3.3% of the global payments. 5.8% of the global payments go to the sponsorship model, i.e. reward-based donations. The next model – investment-based – generates less than 5% of payments, while the hybrid model 0.3% only.

**Table 8.1.** Aggregate funds solicited via active crowdfunding systems, as of 5th June 2014 and 27th February 2015

| | Crowdfunding business model | Aggregate capital (USD m), 5th June 2014 | % | Aggregate capital (USD m), 27th Feb. 2015 | % |
|---|---|---|---|---|---|
| 1. | Non-reward donation model | 20 029.407 | 54.1 | 23 381.673 | 44.5 |
| 2. | Reward-based donation model | 1684.689 | 4.6 | 3036.951 | 5.8 |
| 3. | Lending-based model | 11 948.749 | 32.3 | 21 643.244 | 41.2 |
| 4. | Microfinance-based model | 1391.631 | 3.7 | 1736.889 | 3.3 |
| 5. | Investment-based model | 1813.066 | 4.9 | 2586.307 | 4.9 |
| 6. | Hybrid model | 143.159 | 0.4 | 172.422 | 0.3 |
| 7. | Total: | 37 010.701 | 100.0 | 52 557.486 | 100.0 |

Source: Own elaboration; aggregate capital as of 5th June 2014 – data from author's publication [Dziuba, 2014, p. 100].

The structure of this market has been notably changing over time. The share of non-reward systems dropped from 54.1% to 44.5% and is not dominating any longer. This is owing to the dynamic expansion of other segments, especially the lending-based one, whose share increased from 32.3% to 41.2%, with a distinct advantage of higher value loans for business development or real estate purchase.

The crowdfunding platforms operating in the sponsorship model (reward-based donations), although prevail in terms of quantity, generate a relatively low share (5.8%) of the global stream of payments; most of such payments represent a few platforms only, including Kickstarter.com, Indiegogo.com, GoFundMe.com and HoneyFund.com (the latter one collecting funds for honeymoon expenses).

The share of investment platforms accounts for 5%. One may believe that it is greater in practice (8–10%), since the research was made particularly difficult by restrictions often limiting the access to data to closed groups of investors.

## 8.5. Geographical pattern of the value stream

For the purpose of the present study, we are presenting the geographical pattern of the crowdfunding market's global value distribution, as of 27th February 2015. The summary is presented in Table 8.2.

**Table 8.2.** The value of crowdfunding transactions by countries

| | Countries | Aggregate funds (USD m) | Global share (%) |
|---|---|---|---|
| 1. | USA | 32 463.146 | 61.8 |
| 2. | Great Britain | 14 403.340 | 27.4 |
| 3. | China | 1617.665 | 3.1 |
| 4. | Hong Kong | 1071.436 | 2.0 |
| 5. | Canada | 937.322 | 1.8 |
| 6. | France | 484.787 | 0.9 |
| 7. | Germany | 361.473 | 0.7 |
| 8. | Japan | 254.679 | 0.5 |
| 9. | Netherlands | 247.554 | 0.5 |
| 10. | Other countries | 716.084 | 1.3 |

Source: Own elaboration.

As it might have been expected, the United States, with their USD 32.5 billion, take the greatest share in the market. This accounts for more than 61% of the global value, but should one include joint ventures effected with some other countries, two thirds will be exceeded. This domination is observed in each of the crowdfunding models that have been identified: 53% in the investment-based model, 58% in social/business lending, 60% in non-reward donations, 81% in micro-financing, 87% in hybrid models and 93% in the sponsorship-based systems.

British platforms, on the other hand, generate some 27% of the global value. The total global share of USA and Great Britain is close to 90%. China, with their share in excess of 3%, is also a serious global player, but in this case only selected statistics of the past years are available.

The group referred to as "other countries" includes over 70 states, including South Korea, Poland, Australia, Italy, Finland, Estonia, Denmark, Spain, Israel, Ireland, Argentina, Columbia, Russia, Ukraine. This group was responsible for the total aggregate sum exceeding USD 716 million, i.e. 1.3% of the global value. Crowdfunding systems operating in Poland solicited USD 94.091 million, which accounts for 0.18% of the global value stream only.

## 8.6. Value stream – examples of platforms

Let us now have a look at selected electronic platforms in terms of trends in the aggregate value streams. The findings, categorized by crowdfunding models, are summarized in Table 8.3.

**Table 8.3.** Changes in the value of aggregate capital solicited by selected crowdfunding platforms

| | Aggregate capital (as of 5.06.2014) | Aggregate capital (as of 27.02.2015) | Change (%) |
|---|---|---|---|
| Marketinvoice.com | 188 058 747 (GBP) | 340 676 537 (GBP) | + 81 |
| Seedinvest.com | 164 765 000 (USD) | 414 000 000 (USD) | + 151 |
| Crowdcube.com | 26 376 322 (GBP) | 64 412 376 (GBP) | + 144 |
| Kiva.org | 570 255 300 (USD) | 677 813 625 (USD) | + 19 |
| MicroCredGroup.com | 143 386 657 (USD) | 253 496 783 (USD) | + 77 |
| Prosper.com | 1 000 000 000 (USD) | 2 000 000 000 (USD) | + 100 |
| LendingClub.com | 4 034 212 750 (USD) | 7 620 367 965 (USD) | + 89 |
| SoFi.com | 500 000 000 (USD) | 1 750 000 000 (USD) | + 350 |
| Kickstarter.com | 1 148 855 048 (USD) | 1 557 977 699 (USD) | + 36 |
| StartNext.de | 5 925 017 (EUR) | 17 604 867 (EUR) | + 197 |
| JustGiving.com | 1 500 000 000 (GBP) | 3 500 000 000 (GBP) | + 133 |
| ActBlue.com | 514 439 405 (USD) | 703 661 000 (USD) | + 37 |

Source: Own elaboration.

Investment-based systems represented one of the most dynamically growing segments. For example, the aggregate value of capital generated by Marketinvoice.com increased by 81%, exceeding USD 340 million over the analysed period (from 5.06.2014 to 27.02.2015). In case of Crowdcube.com the growth accounted for 144% and for Seedinvest.com: + 151%.

Higher dynamics were observed in many instances in the social / business lending segment. Hence, for Prosper.com this was + 100% (up to USD 2 billion), the largest lending market today – LendingClub.com grew by 89%, while the value generated by SoFi.com, a platform focussing on student loans, increased more than three and a half times. Similar tendencies took place in the segment of non-reward donations. JustGiving.com, with its +133% growth of the capital value can be given as an example here.

As a rule, high dynamics were observed in the category of sponsor-ship-based crowdfunding platforms. For example, the aggregate funds solicited by StartNext.de almost doubled and the largest system of this type (Kickstarter.com) a 36% growth occurred, up to the sum in excess of USD 1.5 billion.

Platforms with a focus on micro-financing (i.e. micro-credits) are typically less dynamic, due to the lower value of unit payments in this segment. Kiva.org for example increased the value of funds raised by 19% (up to a sum in excess of USD 677 million), while MicroCredGroup.com by + 77%.

This is where changes in the domestic market of electronic platforms are worth mentioning. The charity system SiePomaga.pl for example managed to almost double the value of payments received (up to PLN 19 791 854). A similar tendency was observed for the PolakPotrafi.pl sponsorship-based platform (a growth in excess of 100%, up to PLN 6 282 968). The aggregate value of Wspieram.to almost tripled (up to PLN 1 415 328). The highest aggregate values were generated by lending systems, e.g. Kokos.pl, Finansowo.pl, although with lower dynamics of growth.

## Conclusion

A significant growth of the value stream generated via on-line crowdfunding platforms can be noted over the last few years. Globally, this has been proved to exceed USD 52.5 billion, with a substantial, 42% growth over the period of some eight months.

Crowdfunding is a global business today – such platforms have already been set up on all continents (except Antarctica). The numbers of countries where crowdfunding platforms are implemented is growing[5], therefore – over the last few years – the total share of USA and Europe in the global number of implementations and the global value stream has dropped by a few percentage points.

[5] The number of countries implementing such systems changes over time. For example, according to the research as of 27.02.2015, the Vietnamese platform IG9.vn was not active.

Most of the crowdfunding platforms emerging across the world were set up in the last few years, which is another evidence of the very dynamic growth and prospects this new form of financing is facing. In 2013 alone and until June 2014, about 550 facilities were set up, i.e. more than one-third of the total. On the other hand, values generated by the recently implemented systems do not belong to those highest; the research has identified several systems where no funds at all were collected.

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Chapter 9
# Economic diagnostics in automated business management systems

*Jarosław Olejniczak*

## Introduction

Today, the theory of economic diagnostics offers much more than the Polish economy expects or is able to employ. This is a part of the field most commonly referred to as the "automated management". As an example of the immense and even excessive, one might say, interest in its applications, recent international press accounts of the dramatic, temporary stock market crash can be recalled, when the bogus report of explosions in the White House leaving President Obama injured triggered automatic sell orders. Fortunately, there is no danger of such mistakes here, in these parts. If there is anything to fear, it is the impact of the relatively low economic reliability of the domestic companies. Under the unstable circumstances of the deepening recession, this may determine their fate. In such cases, intelligent diagnostics of the economic standing may become an effective remedy.

## 9.1. The background

Gołuchowski [1997] defines the nature of economic diagnostics, writing that the principal result of diagnostic cognition (reasoning) is an explanation of the reasons of the present, past or future state of things, described by means of the symptoms collected. It is therefore not an aim in itself, but an element of a broader procedure. When following deliberations on the matter of solving economic problems, one may observe that diagnosis is presented, *inter alia*, in the context of:
- organized actions,
- decision-making processes,
- emergency warning systems,
- financial controlling.

The author offers a synthetic explanation of each of the above forms, pointing out that in case of diagnosis being an element of the decision making process, it can be regarded as one of the stages of the company management decision making.

Expressing his view in a more specific manner, the author states [Gołuchowski, 1997]: "Diagnosis of a problem situation, in the context of the company management's decision making, is sometimes included in this process as one of its stages." For example, W. Emory and P. Niland, distinguishing three phases of decision making (goal setting, delineation of possible component tasks, task solving), assumed diagnosis to be a part of delineating tasks that have to be performed in order to achieve the goals set in the first phase of the process. In the course of problem identification, being one of the component tasks, data is analysed, while an effort is made to detect variances (differences, discrepancies) between the actual situation and the pre-defined goal or standard. Should any significant differences occur, they are recorded as symptoms that need to be analysed (identified and clarified) in the course of diagnosis." In the approach presented here, for the first, economic diagnosis is perceived as one of the stages of decision making in the business management process and for the second, differences between the results achieved and the tasks pre-set by the company management are viewed as symptoms. Symptoms indicating an unsatisfactory economic standing may result equally from the wrong goal setting and from the defective task performance as well, or alternatively, from both these deficiencies occurring concurrently. Hence, for the diagnosing of the economic standing to make sense, the correctness of the task setting methodology has also to be controlled and evaluated. It should guarantee a certain, measurable reliability. But if it is to be subject to any formalized evaluation, then it has to be formalized (algorithmized) itself too. This means conscious abandonment of the expert knowledge and relying on knowledge hidden in data being processed by the company transaction systems, as well as in data from the company environment. Namely the amount of hidden knowledge that can be potentially made use of should be the leading criterion for selecting a relevant set of transaction information constituting a direct subject of the diagnostic examination. Consequently, the objective is to develop an intelligent system for diagnosing the economic standing of the company.

What makes this approach to the problem of economic diagnosis in business particularly promising, is its comprehensive and universal nature. Adding economic diagnosing to the long-used and thereby better developed methods of technical diagnostics in business management is undoubtedly another step towards improving the reliability of company operation, where the company is treated as one system. Diagnosing all of its elements should lead to a situation, where one will be able to talk about reliability of this or another company as a whole, making them mutually comparable in this aspect. Under the current circumstances, the need to search for integrated technical and economic solutions is becoming a matter of increasing necessity. With the severe competition on the saturated and often over-saturated market, it is becoming increasingly common for the companies to fall, despite having state-of-the art and reliable technical assets. They are falling because they have failed to assess their economic standing precisely enough. To put it colloquially, it does not matter much, whether a piece of equipment was sent to the scrap yard for being unreliable, or because it has become a part of the bankruptcy estate disposed off by the receiver. At this stage however, the first problem awaiting a satisfactory and practicable solutions is the problem of economic diagnosis effected by methods showing a strictly recognizable level of reliability.

## 9.2. Defining the problem

The process of searching for a formalized, precise diagnosing method requires one to stick to a scope delineated by a precise definition of economic diagnosis. In general, the concept is usually associated with the field of medicine or technology, as well as with its applications in sociology or psychology. The Polish language dictionary provides descriptive definitions of the term, referring these disciplines namely. A more universal explanation can be found in Władysław Kopaliński's dictionary of foreign words and phrases, where diagnosis is defined as "identification, differentiation, decision, distinction". Ziemski [1993] gives a more comprehensive definition, covering also the essence of the procedure: "identifying the state of things being studied through assigning it to a known type or species or through explaining the state of things causally and purposefully, determining its current phase and its expected, further development." Nahotko defines economic diagnosis as "a discipline of science which enables identification and explanation of the company economic and financial standing in both static and dynamic terms" [Nahotko, 1996]. Gołuchowski, on the other hand, defines diagnosis as "a cognitive process – and its outcome – oriented towards developing a rational and as complete as possible explanation of observations of a certain economic reality" [Gołuchowski, 1997]. Economic diagnosing can be effected through:

- making use of the knowledge hidden in data being processed by the company transaction systems,
- the company decision making process,
- analysing deviations from the standard.

A definition of diagnosing the company economic standing requires to be worded in a manner permitting the broadest scope of reference possible, while addressing the economic approach. In consequence, taking the general definitions of diagnosing as a basis and bearing in mind that we are looking for solutions for a manufactirung company, as well as addressing the background discussed above, the following definition has been accepted: a diagnosis of the company economic standing is the identification of causes and effects of its past or future changes.

## 9.3. Initial assumptions

As far as assessment of the company economic standing is concerned, the essence of the problem is not so much the lack of a method to compute the value of symptoms (the so-called indicators) indicating certain deficiencies, as the fact that human experience and intuition need to be used at the stage of interpreting these. Although usually the expertise has been gained over long years of practice and comes from proven specialists, there will always be the hard to measure risk of human error there. These are not the only weak points of the ratio method. Performance indicators not always provide a complete picture of the situation, indicating merely some danger areas, based on standard ratio computations. Such a view is expressed by authors specializing in economics and business management. Shim and Siegel write [Shim et al., 2001]: "Although financial ratio analysis is useful in predicting failure, it is limited because the methodology is basically univariate. Each ratio is examined in isolation, and it is up to the CFO to use professional judgment to determine whether a set of financial ratios are developing into a meaningful analysis." A critical view of using financial control as the sole determinant in the age of information revolution can also be found in the work of Kaplan and Norton [2006] presenting their balanced scorecard tool. Hence, we are facing a situation where on the one hand, a need has emerged to replace the ambiguous methods that have been used so far with a uniform, intelligent system of assessment and on the other hand, adequate IT tools have been developed and can be used for this purpose. Namely, data mining methods, when combined with computer simulation techniques, enable development of Intelligent Systems for Economic Diagnosis, the essence of which has been specified by Gołuchowski [1997].

In a specific case, the diagnostic procedure begins with determining standard values for all items taken into account in the business management practice. The process of diagnosing addresses variances between the standard values and the actual performance. Thus, credibility of "the standard" is becoming a matter of key importance. The system used for generating the standard reference has to be characterized by a high level of accuracy, since the accuracy of generating standard performance values determines efficiency of the entire system. The required accuracy level can be achieved in a self-learning mode, reiterated until the required – pre-defined – level of robustness is achieved. The accuracy, where the outcomes of ex-post calculations on real data will equal or will be sufficiently close to the actual performance of the company will be deemed sufficient.

## 9.4. The scope of diagnosis

A set of data being the direct subject of diagnosing should be determined in such a manner, where:

- it is possible to incorporate all company and environment information which is relevant to the company economic standing,
- the form in which the set is systematized guarantees the facility of searching and detecting interrelations between the analysed items,
- it is possible to disclose as much of the knowledge hidden in available data as possible.

To achieve this, one may:

- use the information collected in those of the existing documents and data beses, that meet the requirements listed above best,
- design a special, dedicated systematics for the purpose of this analysis,
- adopt an indirect method.

The third of these options has been chosen here. The set of data recorded in the complete budget of the company (with the cash flows included) meets the requirements specified above best. Furthermore, it includes all data recorded in other financial documents the company is required to keep, such as: the balance sheet, the profit and loss account, the cash flow statement, the cost account [Olejniczak, Kubiak, 2012]. Moreover, it combines the individual items in a logical computational sequence equally at the stage of planning and execution as well and, which is not meaningless, the very process of its preparation involves some extent of diagnosing too. Some minor additions are needed only. Hence, taking the company budget as a direct subject of diagnosis, the following has been assumed:

1. Causes of changes and their quantitative impact on the economic standing of the company will be determined in pre-defined cycles, e.g. on a monthly and annual basis, where discrepancies between the individual budget performance and the plan items will be analysed in the annual evaluation exercise and the adjusted budget plan items – in the monthly evaluation.
2. Any change within any budget item as well as its impact on each of the cash flow statement items and on the bottom line outcome will be regarded as relevant for the diagnosis.

3. Budget planning will take into account both the company data and any relevant information on the company's economic environment, such as: the demand, the purchasing capacity, the supplier market, the recipient market and the labour market where the company personnel is employed.
4. If the company supplies more than one product, its budget will be represented by the total of independent component budgets drawn up for individual products and such cost items as: company overheads, total sales and shared infrastructure. The budget performance data will be recorded in a similar arrangement.
5. The annual budget planned for the next year (the base budget) will be produced in a breakdown into individual months of the year it covers.
6. After the end of each i-th month, budget performance will be analysed in a similar arrangement as in the base budget and an adjusted monthly budget will be drawn up based on the adequate monthly section of the base budget, as an operational plan for month i+2.
7. In the process of diagnosing, causes of the individual items deviation from the base budget and from the adjusted budget will be identified, with changes in the economic environment characteristics taken into account together with their determinants.

For such a diagnosis to be possible, all of the three forms referred to here have to be available. Budget performance (budget A) is a set of statistical information in a way, with data being collected in a pre-defined arrangement and for pre-defined periods (annual and monthly). The base budget (budget B) is the company's annual budget plan produced in the same form as the budget performance (a year in a breakdown into months). The monthly adjusted budget (budget M) is an operational plan, i.e. a monthly section of the planned annual budget for month i+2, which has been updated based on the i-th month's performance. Certainly, some of the standard analytical methods can be used for compiling various sections of the base budget. As a matter of fact, to collect the budget performance information, nothing else is required than simply effective implementation of the standard financial reporting methods in the company. Yet, as some additional requirements, exceeding the standard scope, will have to be included, especially in order to address the economic environment evolution, the data mining methods can turn out very useful here. This will be the case when searching for information which is missing and is not covered by the available statistics, but can be obtained through approximation, especially when the company's surrounding is concerned. Thus, the base of information necessary to ensure effective diagnostics will be rather comprehensive and not at all easy to create. Not only all standard items of a classic budget will be needed, but also extensions covering cost items and information about the immediate surroundings of the company. Moreover, an appropriate period of time will have to be analysed.

As a result, the budget designed as a set of data constituting a direct basis for diagnosis will consist of the following sections normally specified in any budget:

At the individual product level:

- sales,
- production,
- inventories as of the period end,
- consumption of materials,
- labour,
- production overhead costs,
- cost of planned sales,
- cost of sales.

At the company level:

- total cost of all product groups (manufacturing cost + cost of sales),
- company overheads,
- profit and loss account,
- capital expenditure,
- balance sheet,
- cash flow statement.

Additional data, not recorded in the traditional budget and describing:

- the supplier market,
- the recipient market,
- the employment market,
- the capital market.

The period of time to be taken into account cannot be less than 2 years (the performance estimated for the year preceding the base year and the base year plan).

## 9.5. The method

With the methodology designed here, the diagnostic procedure will be structured into a sequence of the following stages:

A. The stage of planning, consisting of:

1. Specifying the performance of tasks envisaged for the year preceding the base year.
2. Collecting the set of information needed for planning the base year budget (the base budget).

3. Compiling the base budget.
4. Compiling monthly sections of the budget.

B. The stage of actual diagnosing, consisting of:

1. Cyclical, monthly diagnoses, where the i-th month's performance deviations from the base budget, the respective adjusted budget items and the previous month's (i-1) performance, as well as their causes are identified.
2. Calculation of adjustments for the next month, based on the monthly diagnosis.
3. Preparing the annual diagnosis based on monthly diagnoses.
4. Checking the correctness of simulation programs (budget plan simulation for the next month, at the moment when the performance is known and the discrepancies are compared and evaluated).

C. The consolidated evaluation stage, consisting of:

1. An annual ratio analysis.
2. A consolidated evaluation, addressing the correspondence between the initial diagnosis and the ratio analysis outcomes.
3. An identification of the company mobility, based on the budget performance of the year preceding the base year and on the forecasted performance of the base year.

The process of generating information for each budget of any company, as well as the structure of this information, is characterized by three features, all of them being vital in terms of how information is used in the process of diagnosing. Namely, information is:

– interrelated and generated successively, as a consequence of the initially assumed sales level (originally – in terms of volume and thereafter – in terms of value), up to the final cash bottom line,
– grouped in segments, where various segments allow for internal relations regarding: the production volume plan, the selling prices and the production value, costs and cash flows ending with the cash bottom line,
– arranged in cycles, since both the budgeting procedures and the operation itself is repeatable – it repeats each year and in case of monthly budgets used as sections of the annual budget – each month.

This provides favourable conditions for using data mining methods combined with simulation techniques. They can be used effectively in each phase of calculations, at each of the stages listed above, i.e. (as per the above designation): A1, A2, A3, B1, B2, B3, B4, C1, C2, C3. Yet, the following key issues still have to be solved: finding a budgeting method (items A3 and A4), as well as a method for diagnosing the causes of the budget performance variance (items B1 and B3). As a matter of fact, one can assume that if these two issues are solved, the entire problem will be solved, since the remaining matters are far simpler. One should also recall that an intelligent budget system, when designed, will make it possible to generate standard values of all individual budget items, thereby enabling one to diagnose the causes of variances through comparing the analysed period performance.

The sequence of the budget designing cycles includes:

a) calculating the initial sales volume, taking into account the market demand and the company production capacity,
b) estimating the manufacturing cost and the cost of sales (materials, energy, labour, department overheads, cost of sales) and the selling prices,
c) calculating the break-even sales volume,
d) forecasting the financial statements required by the Accounting Act,
e) forecasting the cash flow.

The above sequence of activities that are performed when drawing up a budget, facilitates the process of finding a computation method. Obviously, for cycles d) and e) to be effected, it is sufficient to adopt an appropriate, determined algorithmic approach, using the requirements of the Accounting Act and the outcomes of tasks a), b) and c). But in case of the first three cycles, the deterministic approach will be insufficient. To each of the budget items, one of two features can be assigned – either an item is conditional, i.e. somehow determined by other items of the budget (group S), or it does not depend on other budget items and is a result of an external decision making process (group Z). In the latter case, this can be a result of using intelligent IT procedures or the human will, or simply – an external information we decide to accept and include in the calculations. Obtaining knowledge about the nature of relations binding various budget items – both those arithmetically obvious and those indeterminate as well – which belongs to the first group (group S) and treating all items from the second group (group Z) as inputs, enables one to use a compilation of two different approaches to budget planning and in consequence – to solve the problem. With this end in view, the following should be done:

1. Assume the last year's budget performance (budget A, together with the items of group Z) as a baseline,
2. Disclose the knowledge about relations binding individual items of budget A (in group S), through effecting the required sequence of reiterated simulations, changing the values of all individual items from group Z (one at a time),
3. Accept the knowledge of relations (knowledge A) as sufficient, when the Intelligent Budget System (IBS) operating on its basis enables all of the budget items to be calculated at the same level or a level differing by no more than x% (x% – the acceptable discrepancy, can be computes using the reliability theory relations) from the items of budget A, with all parameters of group Z entered,
4. Determine the value of group Z parameters required for drawing up a budget for the year being planned (budget B).

5. Generate the budget for the period being planned (budget B), using the ISB system and selected elements of group Z and calculating elements of group S – each individual item of the budget will be used as a standard value for the performance diagnosis.

As a result, all individual items of budget B can be used as standard values for the process of diagnosis and on the other hand, knowledge A can be used for identifying the changes of relations between the budget items triggered by our intentional interference in the company processes that will have a positive effect on the company performance. Each and any operation on the budget will result in a lower or higher cash bottomline, which constitutes the final outcome, being a budget control item at the same time. Thus, the on-going monitoring of the effects of each change will be possible. At the same time, further simulations of such changes and selection of a combination resulting in the best financial performance will be an opportunity to optimize efficiency. Intelligent optimization techniques should be recognized for their special, but different role at the stage of determining the initial sales volume, with the limitations resulting from the acceptable level of market demand and the company production capacity. This exercise will be very similar to the standard search of the break-even point, but it will take more realistic, non-linear relations and incomplete, not completely determined factors into consideration.

The problem of diagnosing the company economic standing can only be solved through applying the data mining methods to budgeting. According to the definition adopted earlier in this study, the focus of diagnosing will be on the identification of causes and effects of the changes that have been identified. Also, according to the assumptions presented here, the discrepancy between each individual budget item performance and its standard value, or – to put it more simply – the planned budget (base budget) item, will be deemed to be a change. The identification of causes means finding an answer to the following question: what has caused the given item value to grow or fall and what was the effect of this on the cash bottomline?

The budget (both A and B), just as any other financial document, is a set of data reflecting the material and financial performance of the company, structured according to the applicable principles. Elements of this set can be:

– interrelated in a stictly determined manner – arithmetically interrelated (case D),
– related, but remaining in indeterminate relations (case X),
– unrelated (case 0), i.e. are entered into the budget as unattached elements.

Close interrelations and indeterminate relations between various elements of budget B represent a true replication of the dependencies and relations between the items of budget A. Hence, if an element of budget A differs from the respective element of budget B, then, considering the determinate dependency on the remaining elements of the budget and using the known arithmetic relation, it is possible to indicate, the change and the factor which caused this situation in case D. But if the difference occurs in case X, it will be necessary to use a method, which enables disclosure of hidden non-linear relations or dependencies, e.g. searching for association rules or searching for hidden positive feedbacks.

## Conclusion

Using the budgeting method combined with the data mining methods and simulation techniques in diagnosing the economic standing of a company, enables one to improve effectiveness and accuracy of analysing the influence of individual factors on the financial performance. With this approach, knowledge hidden in standard records of the company financial operations can be utilized more efficiently than in the classic methods (e.g. in ratio analysis), owing to the multiple processing of data in the search of interrelations. Another important finding is the fact that in case of Business Intelligence systems (BI), isolation of the diagnostic procedures from the entire issue of intelligent business management cannot be fully effective, due to incompatibility with the processes that determine the company performance in other areas of its activity. Hence an idea to relate diagnosis to the process of drawing up, monitoring and evaluating the execution of the complete budget of the company being diagnosed. It should be taken into consideration however, that the budget, if adequately adjusted in response to the changing circumstances, is a key document in business management. Therefore, an approach like this should partly correspond with the process of solving the problem of the so-called automated management. Moreover, effective applications of the data mining methods turned out to be much broader than the very issue of diagnosis might imply. An analysis of relations existing within the entire chain of operations required to construct the budget, as well as to monitor and evaluate its performance shows that extensive application of these methods to the business management process is justifiable and even necessary (considering the need of consistent approach).

In case of the BI packages that currently prevail among this type of solutions on the market [Tiedrich, 2003], a strong interrelation between the actual BI system and the transaction systems from which it sources information exists. Often, systems supplied by one and the same manufacturer are required. The budget-based solution proposed here can be implemented independently on the transaction systems existing in the company and the extent of their integration.

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Chapter 10
# Employment restructuring after the ERP system implementation

*Wojciech Truszkowski*

## Introduction

People have always sought to make things easier, facilitate decision making or excuse their mistakes. Erstwhile, decision-makers were assisted by astrologers and fortune-tellers. The fortune-tellers of today – complex computer programs – are capable of presenting the reality or even forecasting the consequences of certain decisions in a user-friendly manner.

The purpose of this paper is to illustrate the influence of an ERP-class IT system deployment on an organization. Employment restructuring, which is an immediate effect of this process, will be discussed. The author will describe the process of implementation and present the changes in the operation of an enterprise X resulting from the ERP-class system deployment. The reader will find out whether the system has met the expectations and will be presented with the new organizational structure and the financial specification of the project.

## 10.1. The process of deployment

The organization had been undergoing minor – cosmetic, so to say – modifications for some time. However, the rapidly evolving business environment enforced more radical alterations, so as to keep up with the situation on the market. The management realized that changes were needed immediately. A decision was made to order an analysis of the company business processes. It took a few months to collect information, as well as to identify and describe the existing processes. This was used as an input to a process performance analysis, which yielded recommendations of activities expected to improve the effectiveness and efficiency of the X company.

The Board kept the employees informed about the plans from the very beginning, presenting the intentions behind commissioning a consultancy to perform the task. There were many in the X company who feared the change – as this is often the case in other companies initiating any transformation. The author did not notice any particularly strong resistance at the first stage of the work, however. The employees were rather willing to talk to the consultants and to explain their job. As a result, the consulting company was able to compile a thorough description of the business process flow and to prepare recommendations.

The Board held regular meetings with the company trade union activists on a monthly basis to inform them about plans, making no secret of the fact that redundancies will follow. Similar meetings were organized for employees of the company business units. Unfortunately, the market of services representing the main source of revenue for X shrank dramatically within a few months, necessitating potential job cuts among the personnel whose work was related to these services. Over time, when the employees realized that the restructuring of employment would be an inescapable final effect of the process, their fear grew stronger. The trade unions were increasingly criticising the Board's doings.

The initial stage of the centralized system deployment involved the company computer equipment replacement. All workstations in all of the company branch offices were to be connected to a server installed at the Company Headquarters. Each of the branch offices needed new hardware enabling appropriate configuration of encrypted tunnels to connect all of the company sites. Furthermore, several old computers had to be replaced in each of the branch offices, as they did not meet the new technical requirements. It took the company IT department about two weeks to carry out this work.

These initial technical arrangements were followed by a pre-implementation audit conducted by specialists representing the system provider. Thereafter, the process of a data base and client applications installation and configuration on terminal computers began. The deployment, which included system installation and configuration, as well as data migration from the previous software, was performed by the system provider and the company IT staff together, this work taking about two weeks. Another week was needed to make adjustments to indexes and some of the imported data, as when the system was made accessible to employees, some errors attributable to the data migration process emerged.

Training was provided to future system operators. Those of the employees who had already had some experience with the old version of the system were hoped to absorb the latest one relatively quickly, so as to be able to help those of their colleagues who were totally new to it. Separate training sessions were organized for different employee groups: the warehouse personnel, the HR staff, the accounting & finance module operators together with cashiers. Each of these one day trainings included hands-on exercises. All participants were provided with detailed written instructions and screenshots illustrating the process step by step. In addition, a special training session for the IT department was held.

The process of feeding archival data to the new system was the last step to be taken before proceeding to the in-operation testing phase. Since previously each of the company branch offices used different computer programs, it was impossible to transfer all historical data to the new data base. System operators had to begin their work with entering archival data. This took about one month, due to various problems encountered. The problems were reported to the IT department and then eliminated on a current basis by the IT staff, in collaboration with the software provider's implementation specialists.

The entire implementation phase, starting from the in-operation testing, took about three months.

## 10.2. Changes to the branch offices workflows

A centralized ERP system with a warehousing module allows for all food, resource and maintenance warehouses in all of the company sites to be interconnected. It is a useful warehouse management tool, all the more so that it is combined with an accounting module. The benefits of this solution translate into the possibility of creating one warehousing unit to support all types of warehouses. The separate warehouse management functions can easily be integrated in one computer workstation controlling the resource, maintenance and food warehouse.

Hence, there is be no need for documents issued by individual warehouses to be entered into the accounting system. With a workflow like this, the warehouse management personnel number could be reduced by one, to take just a single branch office as an example.

The clearings and cash register operation units were rearranged too. It turns out that with the centralized system, much of the inventory control work can be eliminated owing to the real-time access to documents from the Company Headquarters level, where all reporting and analyses can be processed without engaging the branch office personnel. As a result, another full-time position can be eliminated from every branch office.

The implementation of other modules of the system involves business process reengineering, thereby contributing to the reorganization of branch offices administration activities translating into the employment reduction by one full-time post more.

## 10.3. The process of employment restructuring

### 10.3.1. Planning the changes

The Board kept the company trade union organizations informed about the business process automation plans and the resultant employment downsizing. The managers prepared the employees for this moment expected to be challenging for everyone. Meetings were organized, where the advanced restructuring processes were explained to workers by the executive team members. Furthermore, the employee awareness programme included information about the preparations, the employee selection criteria and the redundancy support measures planned.

Line managers, HR specialists and branch office managers were engaged to participate in the employee rating and selection for redundancy procedures. Verification criteria were prepared by the company lawyers.

Main criteria:

- elimination of the position as a result of the reorganization, making further employment impossible,
- eligibility for a position in the new, automated process:
  - previous, overall and on-going assessment of the employee commitment and performance conducted by the immediate manager,
  - professional competence (qualifications, the quality and productivity of work),
- employment status (permanent contracts take priority over fixed term contracts),
- evaluation of the employee's previous performance (objective criteria):
  - preparedness to work flexible hours, absences from work over the 12 months preceding the redundancy procedure,
  - disciplinary record – penalties, inspection findings, customer complaints.

Auxiliary criteria:

- retirement pension entitlement status,
- sources of income other than the salary earned at the X company, e.g.: pension, income from farming,
- property and family status,
- health condition,
- employability.

The employees were offered an opportunity to report any special circumstances that might help avoid dismissal even if someone was originally selected for redundancy. Such aspects as single parenting, caring for a chronically ill person, experiencing financial hardship or having a multi-child family were all taken into consideration by the employer.

Moreover, managers held individual interviews with employees at risk of redundancy, with the purpose of identifying those willing to accept an individual agreement with the employer. They were offered the possibility of employment termination by mutual agreement of the parties initiated by the employer (Table 10.1). Another purpose of these interviews was to inform the groups at risk of the situation in a fair and proper manner and to answer any questions they might have. These meetings were an opportunity for the employees to ask about everything and to receive an explanation of the issues they did not understand. The difference between individual interviews and collective meetings was very distinct: here the employees inquired about all the details and listened carefully. The discussions were topical and calm, bringing the expected results.

The form of the agreement was a matter of concern: some of the trade union activists discouraged the employees to accept it, referring to the fact that it precluded the possibility of going to the court with the employer and questioning the unemployment allowance entitlement of employees who parted with the employer in this way. They claimed that labour offices were interpreting these regulations discretionally, but a legal analysis prepared by a lawyer resolved these doubts.

**Table 10.1.** Employment termination options

| Procedure | Initiated by the employer | Mutual agreement |
|---|---|---|
| Notice period | As per the Corporate Collective Labour Agreement and the Labour Code | As per the Corporate Collective Labour Agreement and the Labour Code |
| Redundancy pay | As per the so-called Collective Redundancy Act | As per the so-called Collective Redundancy Act |
| Extra salary | Not applicable | 1 month |
| Annual leave | To be used over the notice period | Equivalent payment for the unused annual leave |
| Garden leave | No | Yes – from the day following the date of the agreement - pat to be calculated as the annual leave equivalent |
| Termination mode to be indicated in the employment certificate | Art. 30 § 1.2 Termination by the employer | Art. 30 § 1.1 – mutual agreement initiated by the employer |

Source: Author's compilation based on materials provided by the X Company.

When the ultimate number of employees to be dismissed was determined, it turned out that there was no need to launch a collective redundancy procedure and consequently, regulations of the act of 13 March 2003 on special principles for terminating employment with employees for reasons not attributable to employees did not apply. Consequently, it was possible to commence the process without the need to negotiate with the company trade unions. Nevertheless, the Board decided to uphold its proposal of signing termination agreements that were beneficial for the employees. Furthermore, the employees were offered additional support in the form of occupational development workshops and a job search training.

### 10.3.2. Effective termination of employment

For the employment termination to be effective, not only formal requirements have to be satisfied, but the redundancy procedure has to be effected in a humanitarian manner, so as to prevent the employee from bringing a case to the court. From the employer's point of view, it is definitely better to reach a consensus with the employee, even at a higher redundancy cost, the benefits being as follows:

– every type of agreement can be terminated,
– the cause of termination is irrelevant,
– the terms of termination, the date of termination, the garden leave, the redundancy pay and any additional benefits can be agreed flexibly,
– the risk of litigation is reduced.

Having analysed the contracts and agreements signed with an employee to be made redundant and having specified the cause of employment termination, the company had to check the employee's trade union membership and to notify the respective trade union organization of the intention and causes of redundancy. To this end, letters were sent to all trade union organizations represented in the company. Each of the following regulations: art. 38 of the Polish Labour Code and art. 30 of the Trade Union Act specifies a five day statutory period for the company trade unions to reply, this totalling 10 days. After this time, the employer could make a final termination decision.

The termination notices given to employees included an employment termination statement, a true and adequate cause of termination, which was worded in a specific and clear manner, as well as a caution on the right to appeal to the court within 7 days of the date of the termination notice receipt. The notices were handed in by the branch office director, in the presence of the employee's immediate manager.

One of the ways to show respect to the employee is to choose the right place for this action. It is unacceptable to give the termination notice in a hurry, somewhere in a passageway or in the presence of other employees, e.g. by laying the notice on his or her desk. One should wait until the employee undertakes his or her work and invite them to the manager's office. The fact of the employee having started work is an important element, as this prevents them from escaping to a sickness leave. They will not be able to refuse to accept the notice by reporting illness. Even if the employee refuses to accept the termination notice, the manager has witnesses that the employee was present at work and the employee's immediate manager being present witnesses the fact that the employer's will to dismiss the employee was communicated to the employee in a manner compliant with the regulations. One should remember that the employment termination should be stated explicitly to the employee. When the formal procedure is complete, every employee should be thanked for his or her work.

People should be made redundant in a manner one should like to experience oneself – it is important to see a human being in the employee.

### 10.3.3. The new corporate structure

The ERP system implementation allows for the company organizational structure to be rearranged. With the business processes improved, the real-time data access and the instant generation of reports defined in the system, there is less work for the branch offices and for the head office as well. As a result, duplication of some positions existing in each of the business units can be eliminated from the corporate structure and limited to functions responsible for entering data into the system – this is where the territorial vertical chain of command will end. The savings resulting from the fact that there is no need to re-enter data in the Company Head Office translate into the corresponding employment downsizing. This economy has been computed to be an equivalent of 3 full-time positions.

Below, the author summarizes changes to the organizational structure of the company X, which is now arranged into vertical chains of command, with company business units reporting to them. Figure 10.1 illustrates the new structure, which consists of:

- the Company Head Office, including:
    - the strategic chain of command,
    - the financial chain of command,
    - the operating chain of command,
- branch offices – Branch Office A in the city of W, Branch Office B in the city of X, Branch Office C in the city of Y, Branch Office D in the city of Z.

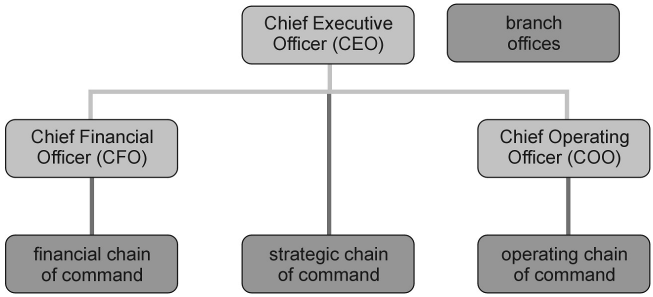


**Figure 10.1.** The new organizational structure of X

Source: Own elaboration based on the X Company Business Rules.

The branch offices are composed of sections (Figure 10.2):

- the Independent Clearing and Cash Operations Function,
- the Administration Section,
- the Warehousing Section,
- the Independent Human Resources Function,
- the Independent Franchise Function.

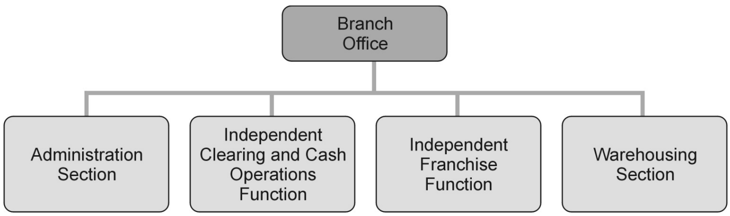


**Figure 10.2.** The new organizational chart of X

Source: Own elaboration based on the X Company Business Rules.

The vertical integration of the company structure improves the corporate business process management and reduces the workforce demand within a single business unit.

## 10.4. Financial effects of the project

Not all costs (Table 10.2) and benefits of the system implementation and employment restructuring project have been summed up yet. At the moment when this paper is being written, the process is still underway, the company still incurring the cost of configuration and software tailoring to its needs. Furthermore, more modules are still awaiting deployment. The employment needs are still being analysed, therefore the process of downsizing cannot be considered complete yet. Since the company had been using an older version of the system before, the whole operation was offered as an upgrade project, with the regular prices reduced accordingly:

– the prices of modules were reduced to 40% of the regular price,
– the SQL services price increased by 25% of the regular price,
– the workstation licence cost was 10% of the regular price,
– the man-hour cost was at the basic level, i.e. PLN 140.

**Table 10.2.** System implementation cost

| Cost item | Additional workstations (in total) | TOTAL |
|---|---|---|
| Module: Accounting and finance | 13 | PLN 4255 |
| Module: HR and payroll | 9 | PLN 6460 |
| Module: Warehouse | 15 | PLN 4375 |
| Module: Cash register operations | 5 | PLN 600 |
| Module: Financial analyses | 2 | PLN 540 |
| Module: Bank transfers | 0 | PLN 1750 |
| Module: Fiscal printer | 4 | PLN 1500 |
| Module: Configurable base (auxiliary module) | n/a | PLN 500 |
| Module: Task executor (auxiliary module) | 1 | PLN 2700 |
| Computer equipment | | PLN 70 000 |
| External experts | | PLN 14 000 |
| **TOTAL** | | **PLN 106 680** |

Source: Author's compilation based on materials provided by the X Company.

Actual savings will be recorded in the next financial year in fact. The whole process of employment downsizing will increase this year's costs due to redundancy payments. If the workforce reduction eliminates three full-time positions per branch office and three full-time positions in the Company Head Office, the economies to be achieved owing to the ERP system implementation will total up to 15 full-time positions. Assuming that the cost of one full-time position amounts to PLN 4000 per month, the next year savings will be several times higher than the implementation project cost.

## Conclusion

The purpose of this paper was to illustrate the influence of an ERP-class IT system deployment on an organization. The discussion shows clearly that in addition to business skills and strategic thinking, a manager needs to be a leader and have some knowledge of psychology.

The author has demonstrated that the steps taken by the X Company Board mitigated the consequences of business restructuring and calmed tensions among the employees. Owing to the collective meetings and, first of all, individual interviews with the employees at the risk of redundancy, protests were avoided and some degree of understanding and acceptance of the changes was achieved. Most employees realized that the transformation was necessary for the company to survive and grow.

The economies forecasted for the first year following the system implementation and employment downsizing support the author's thesis that the ERP system has a direct effect on the organization's financial performance, translating into a significant cost reduction.

The author has proved that it is possible to guide an organization through a process of thorough changes in a relatively painless and, what is most important, effective manner, while remaining human in the eyes of other people.

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Chapter 11
# Why does biology need informatics, and does informatics need biology?

*Grzegorz Węgrzyn, Alicja Węgrzyn*

## Introduction

Biological entities are characterized by enormous diversity. Currently, there are about $1.5\times10^6$ known and named species on the Earth, however, it is estimated that the number of actually existing species is between $2\times10^6$ and $100\times10^6$ [Milo et al., 2010]. There are different number of creatures of the same kind or species. For example, there are about $7\times10^9$ humans, which appears to be a relatively small number relative to the number of bacteria and bacteriophages (virsues which infect bacterial cells), estimated as $10^{30}$ and $10^{31}$, respectively [Breitbart, Rohwer, 2005]. When considering human body, one can estimate that there are about $10^{13}$ cells which build one such organism, while number of bacteria living in the human gut and on the human skin is ten times higher, i.e. $10^{14}$. Number of neurons in the human brain cortex is about $5\times10^{10}$, while number of synapses (the connections between neurons) is $3.6\times10^{14}$ [Milo et al., 2010].

Each organism has a genetic information in the form of nucleic acid (polymers of nucleotides), DNA in most cases and RNA in some viruses. In a cellular organism, all or most of cells contain DNA, and the total genetic information included in one cell or one virus particle is called a genome. The genetic information is "written" in the form of nucleotide sequence, i.e. the sequence of four kinds of bases occurring in nucleotides, called adenine (A), guanine (G), cytosine (C) and thymine (T). The sizes of genomes vary significantly, from a few thousands of nucleotides in some viruses, to the range of $10^{13}$ nucleotide (or base) pairs in some plants [Milo et al., 2010]. In the NCBI database (http://www.ncbi.nlm.nih.gov/genome) of National Institutes of Health (USA), information about genomes of over 2000 eukaryotic organisms, 32 500 prokaryotic organisms, 4500 viruses, 5500 plasmids, and 6500 organelles can be found. Therefore, it is obvious that the amount of available biological information is growing rapidly.

## 11.1. How to analyse large body of biological data?

As presented briefly in Introduction, biological diversity on Earth is enormous, and the level of complication of even small organisms is huge. Moreover, amount of information about genomes increases rapidly. While the first genomes (even those of small viruses, composed of several thousand pairs of nucleotides) were being sequenced for years, currently, with the use of one sequencing machine of new generation, it is possible to sequence 5 human genomes ($6\times10^9$ base pairs each) within one day [Bao et al., 2014].

The information about the sequence of nucleotides in DNA is only the beginning of the way to understand the biological mechanisms or functions of cells and organisms. Genes are fragments of DNA strands, and their actual functions are expressed due to differential activities of particular promoters under various physiological conditions and in different types of cells in the same organism. Therefore, studies on functions of genes are particularly important, but also especially complicated. Current technologies, like DNA microarrays [Gabig, Węgrzyn, 2001] or RNA sequencing [Capobianco, 2014] allow for determination of activities of all genes in tested cells under certain conditions.

It is obvious that analysis of such a large amount of data is very complicated. In fact, even analysis of results of a single experiment requires advanced informatic tools, as it is not possible to consider the whole set of data obtained from a microarray or sequencing study. Often, results from many studies are compared, and then the analysis is even more complicated, though conclusions can be particularly interesting. For example, analysis of DNA sequences from different organisms can lead to hypotheses about their relationships and evolution. This can be investigated at the level of gene sequence or gene expression regulation [Fuellen, 2011].

Above, only a few examples of the level of complexity of current biological results and data are presented. Nevertheless, it is clear that to analyse results of vast majority of biological experiments, advanced bioinformatics is required.

## 11.2. Why does biology need informatics?

The statement that computer-based analysis is necessary for most biological experiments is perhaps trivial. Probably the same is true in majority of other scientific disciplines. However, current biological studies require something more than just tools to compare a large body of data obtained from experimental measurements. Namely, current biology needs specific ideas of how to analyse data in order to draw logic conclusions, when it is obvious that the number of variables is so high that determining all of them and presenting an unequivocal explanation is impossible. It is worth to note that a change of a single parameter in cell culture or addition of a single natural compound to such a culture usually results in significant changes in expression of hundreds of genes [Moskot et al., 2014]. If one considers that in the whole multi-cellular organism, like a human, there are many different kinds of cells, forming different tissues and organs, and there are hundreds, if not thousands, of factors and agents interacting with our physiology, it is obvious that using simple calculations it is not possible to predict effects of any compound on the organism. On the other hand, it is necessary to understand how particular environmental factors influence our body, how a putative drug may act on different tissues or what mixtures of agents can be deleterious for the organism. There are only a few examples of problems met by current biologists. Without novel ideas on ways to analyse biological processes, further development of biology would be impossible.

To illustrate the level of complexity of biological systems, regulation of one step of development of a simple virus is demonstrated in Figure 11.1. Bacteriophage l is a virus infecting cells of a bacterium, *Escherichia coli*. Upon infection, this virus have to chose one of two possible developmental pathways: lytic (leading to production of progeny viruses in the host cell) or lysogenic (based on integration of the virus DNA into the genetic material of the host cell). Depending on environmental conditions, especially temperature, availability of nutrients, and number of viruses simultaneously infecting a bacterial cell, one of these two options in chosen. The regulation of the "lysis-versus-lysogenization" decision must be precise, as entering an inappropriate developmental pathway may result in ineffective virus propagation, causing its elimination [Węgrzyn et al., 2012].

Our intention to present the scheme in Figure 11.1 is not to provide detailed information about the regulatory mechanism, but to show the level of complexity of one of the simplest biological decisions. One should note that each symbol written in Figure 11.1 in *italic* represents one gene, and each box or symbol written in Roman font represents a protein or RNA molecule. Since nucleotide sequences of all genes of bacteriophage l are known, and biochemical functions of most of proteins have been demonstrated, our knowledge on the system might appear considerable. However, apart from identification of many interactions, dependences, and interplay events, demonstrated schematically in Figure 11.1, it is still not possible to predict precisely which developmental pathway will be chosen by a particular phage under particular conditions. We can only estimate that lytic or lysogenic pathway will be predominant, but it is not possible to predict what percentage of viruses infecting the host cells will produce progeny bacteriophages and what percentage will integrate their genomes with the host DNA. The results may vary from experiment to experiment.

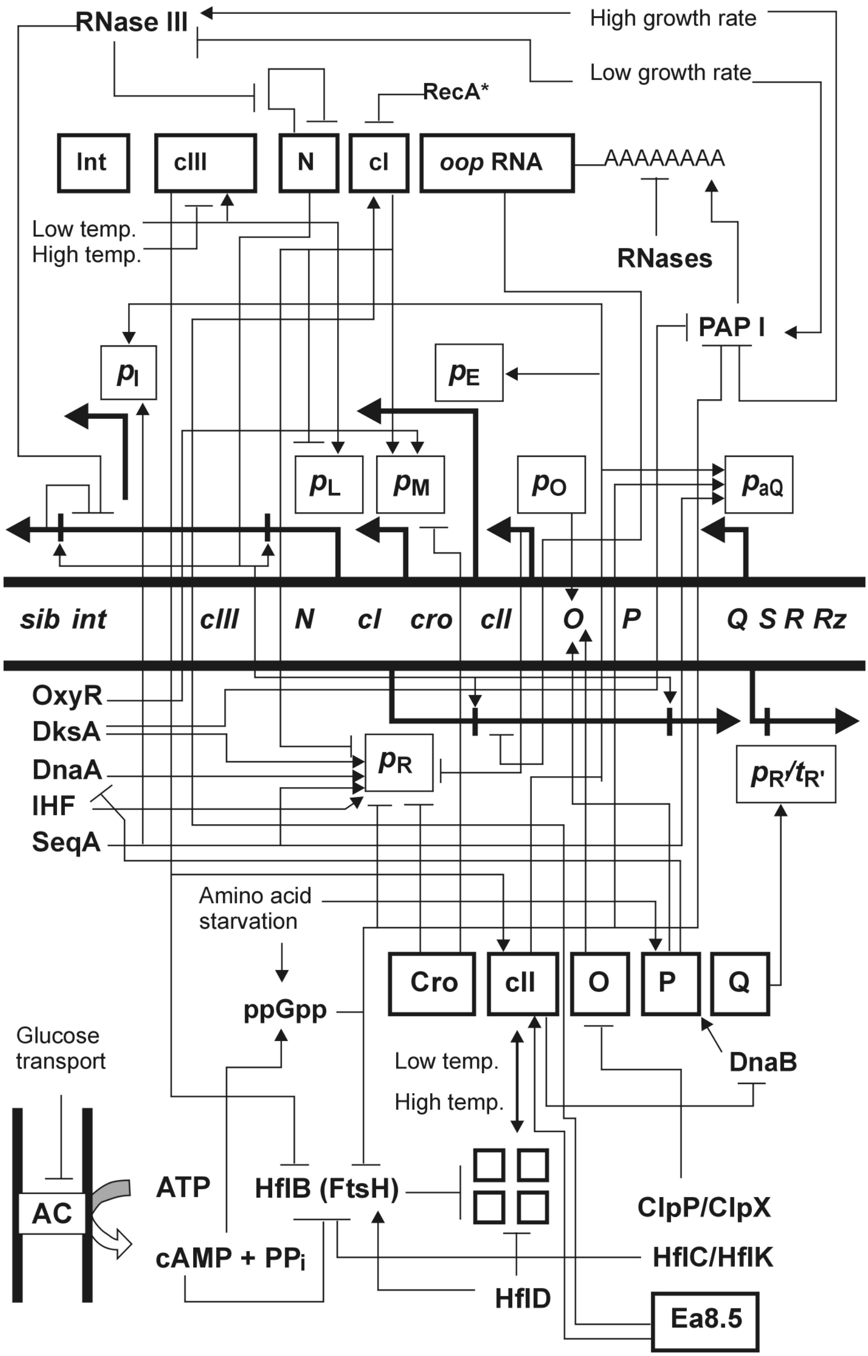


**Figure 11.1.** Regulation of the decision phase of development of bacteriophage l upon infection of its host, *Escherichia coli*. Arrows indicate positive regulation (stimulation) and blunt-ended lines indicate negative regulation (inhibition).

Source: modified version of that published earlier [Węgrzyn, 2014].

Remembering that the biological system presented in Figure 11.1 is one of the simplest found in living organisms, one might try to imagine the level of complexity of processes occurring in human cells, and human body. It is obvious that we are not able to consider all data we have, and the number of possible interactions is so high that prediction of all their results is impossible. On the other hand, the intention of biologists is to understand the regulatory mechanisms. This may be possible not only if sophisticated tools of bioinformatics are available, but also if ideas how to analyse the available data appear. Since prediction of all potential scenarios is not possible, it is necessary to develop methods of meta-analyses in which large body of results can be considered while at the same time a general schemes may be build based on information from which only common conclusions could be drawn. Therefore, development of not only novel softwares but also novel analytical methods is highly desirable in biology. Usually, collaboration between biologists and specialists in the field of informatics is not easy, as experimental methods employed in biology require very different assumptions and different way of thinking than computing. Moreover, many biologists do not know details of programming, and specialists in informatics are not always familiar with biological processes under study. Nevertheless, their collaboration is undoubtedly necessary.

## 11.3. Does informatics need biology?

As indicated in section 11.2, current biology needs informatics. But does informatics need biology? We suggest that yes, if a specialist in the field of computing wants to solve really non-trivial problems. Obviously, such experts may realize their research in the fields of economy or banking. We agree that there are serious problems in these disciplines which require advanced informatics. However, we also suggest that biological problems are generally more challenging than those from the fields of economy or banking. Although economical processes are not simple, the major difference between them and biological processes is that in economy, all rules and variables have been created by humans, thus, one can distinguish and identify them. In contrast, in biology all factors and processes have been created by nature, and most probably we do not even know about many of them. Therefore, in economy a researcher considers mechanisms which were created, so even if they are complicated and if there are many of them, all are identifiable. In biology, we are still discovering previously unknown factors, reactions, processes and mechanisms. Thus, when creating a new biological model or proposing a new biological hypothesis, it is necessary to remember that perhaps there are mechanisms which influence the studied process but which were not yet recognized by us. This may be very challenging, but on the other hand, such studies may be very attractive for ambitious researchers who are specialists in informatics. There is an opportunity to introduce even new fields of research.

An example of an emerging field of study has been reported recently [Pamjav et al., 2012]. The authors performed a computer-aided comparison of folk music from different nations. However, they also identified similarities between phylogenetic studies and modern folk music. Interestingly, both of them use similar concepts and representation tools such as multidimensional scaling for modelling relationship between populations. Thus, the authors investigated whether these connections are merely accidental or if they mirror population migrations from the past. Interestingly, it was observed that there is a significant correlation between population genetics and folk music. Maternal lineages appeared to have a more important role in folk music traditions than paternal lineages. Undoubtedly, this kind of research indicate novel and exciting possibilities of bio-informatics.

## Conclusion

We conclude that not only biology needs informatics, due to complexity and the size of biological data, but also informatics needs biology if one wants to solve very challenging while fascinating and important interdisciplinary problems.

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Chapter 12

# Innovative information and communication technologies in the Polish banking sector

*Jerzy Gwizdała, Sebastian Susmarski*

## Introduction

Modern information and communication technologies enter into all spheres of economic life. Visible effects of this process are also present in the financial sector. Banks too are a subject of the technological evolution. Economic development as well as the creation and use of modern technology as a result of the technological revolution leads to the transformation of the needs of all participants of the market process with the customer in the first place.

Banking in Poland is one of those sectors of economy in which new technologies are being introduced fast. Progress in the field of computer applications greatly contributes to the improvement of the organization, performance and efficiency of banks. The development of information technologies, the Internet and telecommunications infrastructure opened up new opportunities for the banks and created new quality for their customers. IT systems are now an integral part of the infrastructure of each bank and significantly affect the level of its profits, thereby are a deciding factor for the success or failure of a bank.

The banking sector in Poland, despite the delays in relation to developed countries, sees a very dynamic process of implementation and application of technical and technological innovations. In Poland, the delay in the development of banking technology in comparison with other European countries was mainly due to the limited availability of modern computers, computer systems and the Internet. This distance though now results in a great potential for development of Polish banks. They are moving through the stages, using the experience of other countries, and thus do not need to implement solutions that have not worked or have been of a temporary nature.

The purpose of this article is to present the role of modern information and communication technologies in the Polish banking sector, their development, evolution, the near future as well as significant problems in their functioning.

## 12.1. The development of information and communication technologies in the banking sector

In spite of appearances, "modern" technologies are not the product of the dynamic development of the past few decades. Technology in the modern banking sector plays a fundamental role and unquestionably decides on its existence and shape. It allows the banks to provide more efficient customer service and faster data processing, new methods of access to financial services as well as their more rapid development. It also enables the introduction of services that would not exist without technology.

Commercial banks besides the use of modern technology related to their internal organization and the specificity of business activity, must also take into account the technologies present in non-banking areas. They will influence customers' behaviour and their interaction with the bank as a result of socio-cultural changes that they have triggered. The main area where this can be observed is generally the communication with the customer where the bank uses channels of communication and distribution of banking services.

What is crucial for banking activities, however, is still "the human factor". This is due to the huge number of decisions that must be continually taken in granting loans, taking deposits, issuing guarantees and sureties as well as in the course of carrying out inter-bank operations and managing cash resources. These tasks cannot be performed in a totally automated way. They require informed decisions – based on experience, ability to draw conclusions and accurate assessment of the situation. However, the speed and efficiency of staff often depend on technical equipment and technological capacity. At the same time, modern equipment and implemented innovations allow for easy retrieval of data (practically inaccessible without them) providing a good basis for decision-making. That is why the factor of technical equipment begins to play an increasingly important role in every bank.

The use of modern technology has profoundly changed operating conditions of banks and opened up new prospects for development. At the same time the variety of the results of this development is enormous [Oręziak, Pietrzak, 2000, p. 144].

The development of innovative banking technologies shows that their introduction not only increases efficiency but also enables new ways of servicing a customer or an implementation of new products and services. The reason for the changes and the modernization of technology was the need to improve the efficiency of bank's operations, quality of customer service and maintaining flexibility of solutions implemented and retaining security.

The above mentioned technologies include mainly internal IT systems and are associated with bank's operation. Their implementation has been enabled by the overall technological progress in the field of computer science.

Technology influences the banking sector in following ways:

– directly (internally) – as a result of using specific technological solutions within banking systems, banks as organizations change their way of operating;
– indirectly (externally) – due to its impact on customers (and other elements of the environment) who get to know, accept and use new technologies, banks are forced to seek new possibilities of applying these solutions [Ozimek, Moszczyński, 2001, p. 36].

Banks use modern solutions related not only to their internal structure. Increasingly, they must also take into account those technologies that apply to other non-banking areas of life and as a result cause socio-cultural changes that influence customer's behaviour and modify their interaction with the bank. A fundamental example is the Internet. The development of a global network has created a whole set of internet-communication technologies such as programming languages, specialized network protocols, page and data description or access applications. These tools enabled the creation of network services such as electronic mail, remote access servers (Telnet), file transfer (FTP) or the distribution and storage of hypertext documents (WWW). It is not without significance that most of the Internet innovations and initiatives were of non-commercial character and beyond any corporation, and at the same time were quite well formalized and standardized. As a result they have developed faster and retained their democratic character.

The habits and expectations of users were shaped by the ubiquity and ease of use of the universal and commonly available browsers displaying web content in a graphic form.

The success of the concept and technologies developing along with the evolution of the Internet resulted in the development of their off-line applications (e.g. corporate intranets). There have been a number of initiatives for commercial use having its source in web technologies.

The emergence and rapid growth of the Internet has changed the awareness of ICT users. As a result, a new trend known today as the information society began to spring up.

The other type of technology that has had a significant impact on the behaviour of customers is mobile technology and its derivatives. Stationary telephony was a subject to revolutionary changes, too. It was done mainly by the ISDN digital solutions, the expansion of call center solutions and IVR (changing text/digital input into voice) and is an important communication medium. The exponential development of applications, due to strong competition in the market, caused the cell phone to take over the functions of other devices, such as a notebook or diary, an electronic game console, a calculator, a computer or a digital camera. Mobile phones have now access to global web resources and Internet services. New technologies more widely used in mobile phones has given true meaning to the concept of mobility and perfectly matched the tastes and expectations of customers [Pietrzak, 2002, p. 37].

Obviously, the very existence of this new technology does not automatically mean the obligation of using it by the bank. However, there is such pressure when a specific technology becomes standard and is used by the competition or when technological innovation is fully accepted by users and is seen by them as a standard (e.g. access to information and services on the web).

Therefore, the use of new technologies by the banks results [Stryczyński, Zarzycki, 2000, p. 58]:
- transition of banking to the "information business";
- the reduction of barriers for new banking products to enter the market;
- the increase of products' competitiveness;
- cost reduction;
- the possibility of a comprehensive and centralized processing of customer data, their accounts, transactions and other events important for a planned strategy of the bank, for instance;
- unification and standardization of procedures and services at a high level;
- unification of distribution channels so that the customer may expect the same final result no matter which channel they use to make a transaction;
- possible diversification of products and services;
- the ability to integrate different services in a single product;
- the emergence of mechanisms to support the processes deriving from globalization, including in particular cross-border access to financial services;
- changes in the organizational structure and staffing of banks;
- the emergence of new ways and strategies of promotion;

In order to obtain benefits from the use of information and communication technology certain challenges need to be addressed. Banks choosing to use a specific technology (including all those related to e-banking) should take into account:
- the need for a relatively easy integration with existing systems;
- the necessity of adjusting technological solutions to changes in bank's strategy, the way of doing business (business logic) and marketing plans;
- the fact that the technology used in banks is no longer specific which means the relative ease of acquiring it and this shows that the mere possession of a given technology does not build a competitive advantage;

- the fact that the pace and variety of technological change is a risk associated with missing the right time to introduce them in a bank (rapid deployment is usually more expensive and results in the syndrome of "being a pioneer," while late introduction may mean a loss of customers beforehand);
- correlation with the expectations and preferences of customers in terms of the technologies used and the associated risks (objectively attractive technology may not be accepted, while a seemingly unattractive technology can gain wide acceptance, as exemplified by the unexpected "text message boom");
- efficiency, effectiveness and safety of new technological solutions that must be practically without reservations; this is primarily due to carrying out financial operations.

Information and communication technologies are changing, evolving, some are no longer applicable and they end their "career". They are substituted by new, better, faster, more efficient, or simply better ones meet the expectations and needs of users. The impact of modern technology on the development of banking services was huge. The result most visible for the customer was to facilitate access to financial products and services, reducing the time of service, generally perceived by the customers as convenience. Technologies are a tool for banks to create new and develop existing areas of their activity, at the same time observing customers' expectations and acceptance.

Continuous process of "digitization" in the financial sector, including banking, fundamentally changes the operating conditions in a rapidly changing market. Expenditure incurred in the introduction of modern technologies consume huge sums, but they are a necessary investment. The long-term goal is an adequate level of return on investment. The first step toward this goal is, inter alia, to improve the quality of services provided and to refocus from product-oriented activities to the customer-oriented ones. The use of modern technologies in the banks' business activities is to ultimately improve their performance. Ubiquitous technology is a means to change the face of banks, from conservative and monumental institutions to modern, efficient, customer-friendly financial companies, providing comprehensive services tailored to customers' needs and expectations [Pluskota, 2003, p. 163–164]. Automation of equipment and sales should increase the bank's competitive advantage also over non-bank institutions.

Table 12.1 presents analysis of the consequences of processes of the banking sector shows the costs and benefits of this phenomenon on a macroeconomic, mezoeconomic and microeconomic scale. Despite many threats posed by this process, the introduction of new technologies is a necessary and indispensable phenomenon for banks in order to face the competition and meet the expectations of customers. Banks must change its conservative image to exist in the modern market.

**Table 12.1.** Main consequences of the process of "digitization" in banking and financial sector

| Level of analysis | | Costs / risks | Benefits / opportunities |
|---|---|---|---|
| Macroeconomic | Developed countries | Internet crime (piracy, hackers)<br>unreasonably large scale of investments in the Internet | global market with no borders<br>a higher level of efficiency in the allocation of resources<br>the benefits of leadership in e-finance (mainly in the US) |
| | Post-communist countries (including Poland) | relative underdevelopment in the field of ICT and telecommunications<br>the risk of marginalization | possibility of intelligent imitation of highly developed countries (escape forward)<br>development of IT education for the new economy |
| Mezoeconomic | Sectors, branches, industries | learn ranking<br>"creative destruction" – a gradual fall of declining industries | development of new economy industries<br>market transparency<br>lower transaction costs |
| | Regions, subregions | relative underdevelopment of regions dominated by "old economy" | new growth poles – subregions dominated by "new economy" |
| Microeconomic | Businesses and non-financial firms | costs of investment in Internet technologies<br>limited access to the Internet for SMEs | reduction of costs of handling financial transactions |
| | Banks and other financial companies | expenses associated with investing in hardware and software<br>competition from shadow banks<br>internal competition ("cannibalism" – eliminating parent company by its subsidiary) | cost savings<br>increase in the amount of available information and the speed of its flow<br>development of Customer Relationship Management (CRM) |
| | Households (customers) | relatively low (but growing) number of Internet users<br>lack of full confidence in the security of e-finance<br>difficulties in adapting to the modern banking technology (mainly for the older generation of customers) | "democratization" of the financial market<br>transparency of financial market<br>benefits for customers (price, time, quality)<br>increase in the bargaining power of customers |

Source: Own elaboration.

## 12.2. Methods of reducing the risk in online banking

Wide geographical coverage, availability and anonymity on the Internet requires banks to maintain a constant concern for the security of information systems. Types of risk specific for the operations related to electronic money can be grouped according to the main types of risk characteristic of other activities. In the electronic banking operational and legal risk as well as reputation come to the fore.

Operational risk depends on the probability of losses of the bank due to insufficient certainty and consistency of the electronic and computer system. E-banking products and electronic money itself are exposed to a potential attempt to "break the system" for criminal purposes. This "attack" on the existing system can be external, but can also come from within the system. It is often a result of an incorrect audit procedure and the organizational structure. It may also be caused by policies not properly adapted to the speed of transactions and the wide range of electronic distribution channels. Another problem is the incompetence of managers or people operating internet banking services.

Legal risk takes a variety of forms. Banks constantly modify the rules and must be up to date with all the law amendments. Furthermore, banks that offer their products to customers from other countries via the Internet and other distribution channels are obliged to comply with the regulations of the host country, often differently treating various issues, such as protection of an e-banking customer. Another obstacle is the lack of acceptance of certain documents in an electronic form in some countries. Also, there is a possibility of unforeseen obligations resulting from customers' or other financial market participants' requests.

Reputational risk refers to the influence of errors in the operation of information systems on public opinion and the change of the bank's image. The risk of losing a good image appears when the IT systems are subject to external or internal attacks resulting in the loss of the bank or its customers. The loss of "good reputation" can also occur as a result of "normal" erroneous operation of the system which will bring discomfort of using the bank's services to its customers. This risk is important not only for a single bank, but for the entire banking system. Social behaviours within the entire banking system are subject to the transmission of behaviour and spread to other banks as well. The risk of damaging the public perception of the bank's image may occur due to wrong associations of one banking product with a product of another bank that is faulty or has other negative marketing features. If customers are faced with difficulties when using one banking product, they can move this assessment for the whole class of such services, even those offered by another bank. External attack can be aimed directly at bank's reputation. This can be, for example, hacking a bank's website and changing information on the bank and its products.

The likelihood of criminal activity in the electronic banking system is higher than in the traditional one, because of a high anonymity in carrying them out and the lack of paper traces of the transaction. Reliable statistics on the detection of computer fraud are very hard to find for clear reasons: the offenses are usually covered up by the organizations involved in them. Panda Security analysts have conducted a study which shows that using applications such as rogueware, cybermafia earns monthly 34 million US dollars. At the same time 35 million computers are infected with fake protective applications. Rogueware or scareware are software designed to mislead the user by creating a false or exaggerated alarm about the threat of a virus or bug infection. Rogueware automatically scans your computer and then informs the user about the alleged infection. The next step is a recommendation to purchase a license for the full version of "anti-virus" to delete the apparently detected malicious codes. This is only a lure that is designed to make the unconscious users buy the false safety applications.

Cybercriminals do not only attack banks' websites, but also web hosting companies running them. A hosting provider belonging to the group Goldleaf Financial Solutions was a victim of such an attack and as a result it was necessary to change all customers' passwords and logins. Programs used for attacks using a series of programs that interfere with systems are called rabbit virus. They reproduce in order to destroy the system through its blocking. They transfer to the system in the network and leave viruses or Trojans, i.e. programs that violate the security of the system by stealing passwords. Trojans, bots, dialers, adware, spyware, etc. are everywhere, not only in the targeted banking sites. Every day there are more and more Trojans, especially banking Trojans. This virus is one of the most dangerous varieties introduced to the application on the infected computer for new features to improve their effectiveness, it can even capture video. To put the Trojans to the computers, cybercriminals exploit vulnerabilities in the software, but the worst part is that they spread without the user's knowledge, which makes them dangerous. Some criminals are able to make these changes in your computer, that when you access to sites such as online store or bank service then appears on the screen of his perfect copy. In this way, the user sees a fake website by entering the number of their data there not expecting anything wrong with that.

Apart from threats such as computer viruses and bugs or so called holes (vulnerabilities) in browsers, there is yet another danger. The threat which is common both for the client and the server is the process of transferring data. The typical risks include sniffing, i.e. eavesdropping on the network to capture the broadcast content. Another one is spoofing, i.e. masquerading as another computer belonging to the network and thus taking over the user's session together with the machine. The threats leading to the acquisition of the server or the destruction of its resources include unauthorized access to the system through the so-called backdoor. These methods allow you to bypass security, attacks on database resources as well as sabotage and cyber terrorism. Errors and omissions by the people who operate the system also belong to this group. The risks associated with customer consist primarily of problems with incorrect logging on and use of the system. An increasingly common threat is phishing (fishing passwords). It involves sending bank customers emails with a request to log on a "counterfeit" bank website. These sites have slightly altered www addresses [Wawrzyniak, 2005, p. 75–77]. All the IT risks to banking transactions can be generally divided into those that occur outside the bank and those that occur inside the bank (Table 12.2).

**Table 12.2.** Division of risks in e-banking transactions

| Bank | Customer |
|---|---|
| Eliminating the possibility of bypass authentication system.<br>Protecting the confidentiality of password.<br>Protecting the confidentiality of the set of encrypted passwords.<br>Protecting the integrity of computer operations.<br>Protecting the integrity of the logs. | Protecting the confidentiality of password.<br>Protecting the confidentiality of one-time passwords (OTPs)<br>Anti-virus protection<br>Restricting access to one's computer<br>Securing Wi-Fi |

Source: Own elaboration based on [Solarz, 2006, p. 230].

The need to ensure the safety of e-banking operations has become increasingly important as banks use very complex systems created by a network of many different terminals of a high diversity of geographical locations. Inadequate protection of these systems when used for the electronic banking can directly result in "artificial" bank liabilities, the emergence of additional commitments of bank customers or direct losses. Therefore, it seems that the authentication is one of the most essential tasks of ensuring security in banking information systems. The use of authentication procedures introduces in the computer system the access control to resources at various levels of the organization and eliminates the risk of unauthorized access to system resources.

The development of operational systems using software which provides an adequate level of stability of necessary applications, is the most common form of preventing third parties. An example is the Trusted Operating System using the UNIX software for the Security First Network Bank, i.e. the first truly virtual banking institution. Another technique involving the use of tools serving as the access key to the system is characterized by a high degree of uniqueness of the characters generated by the algorithm. An example can be the one-time password (dynamic) system created by a cryptographic calculator (so called token), otherwise known as electronic signature generator that was used in Omega OE applications in Pekao SA bank. This tool is a separate element of the whole set of security measures used and functions independently of the standard logging with the use of user ID and password in order to gain access to your account. Cryptographic calculator allows access to the account after entering the sequence of digits generated by it into the interface on the electronic branch site. The combination of numbers generated depends on the prior entry into the calculator another string of digits specified by the branch website. The digits change each time the customer accesses the system. The calculator converts the entered combination according to an algorithm which makes the conversion depending on the time of the transaction. The conversion of digital information in the cryptographic calculator guarantees that at the moment no other user of the system will receive the same sequence of numbers. In order to access one's account, one needs to enter into the cryptographic calculator a system ID and password received from the bank, six-digit personal identification number and a string of numbers from the bank's website interface and at the same time type the string of numbers to the right place on the bank's website. Only then it is possible to access the account. All data related to banking transactions, electronic correspondence obtaining additional information as well as any data exchange between the client and the bank or vice versa is encrypted [Prokopowicz, 2009, p. 71–73].

Due to the size of the potential risks, financial institutions must apply advanced solutions whose main goal is to effectively secure data and customers' cash. The most frequently used online banking security measures include:

- protection of bank's IT system,
- encryption of data transmission,
- electronic signature,
- automatic monitoring of operations and transactions
- tokens,
- passwords, user IDs, certificates,
- OTPs,
- transaction authentication numbers (so called TAN),
- password masking, virtual keyboards,
- image files and other items to identify the authenticity of the displayed page,
- cryptographic smart cards,

Awareness of financial crimes committed in the worldwide web among Internet banking customers is high. In order to avoid a possible attack one must remember a few details. Banks will never ask you to provide any confidential information over the Internet. One must not respond to unsolicited e-mail requesting verification or disclosure of personal data, information on the account number or a credit card. In case of attempts to obtain such (seemingly trivial) information one should contact one's bank by telephone or in person and confirm the request. Besides, one should regularly check one's disk with anti-virus software to eliminate hidden viruses and Trojans. It is recommended to perform the security scan as often as possible and to update the operating system from manufacturer's site.

## Conclusion

Banking has always been characterized by dynamics and development arising from the need for a rapid response to emerging needs and expectations of customers. As a result of the trends in the financial markets and the liberalization of capital flow and turnover, banks in the twenty-first century must accelerate further action on the creation of new financial instruments and funding techniques offered in an increasingly global and competitive financial market. Along with computerization and the advent of information society, banks face new challenges. Banking development trends in the world are increasingly dominated by modern technology, including all those related to the Internet. Their use is one of the effects of globalization at large, which leads, among others, to the disappearance of the territorial boundaries of the capital and changes in the prevailing relationship between banks and customers.

The reasons for using modern information and communication technologies in banks can be considered in two aspects. Firstly, as a result of economic and technological development in the world and a consistent trend of modern technology entering in all areas of human activity. Second, the desire to improve results by searching for new profit areas and more efficient management has led to changes in work organization and evolution in the distribution strategy. This would not be possible without the widespread use of technical and technological innovation in banks.

Intensive use of modern technologies has increased competition in the banking market, forced to search for new channels of access to funds deposited in bank accounts and offered new forms of communication with the bank. Practical use of modern technologies in the financial market has led to the emergence of electronic banking which allows access to a bank account through an ATM, phone, computer and web browser, i.e. remote forms of contact. The important thing is the speed that e-banking develops and disseminates globally with. While the successive development stages of traditional banking lasted decades or even hundreds of years, the advanced remote access to banking services virtually engulfed the entire civilized world within just a few years.

Recently, the competition across the financial services market has also been increasing. In order to meet the competition, banks are trying to implement a number of initiatives, including activities to improve streamlining and internal communication as well as to offer innovative products and services and new access channels for customers. Financial market sees more and more new players, especially non-banking institutions that are beginning to offer integrated financial products and thus become a serious competitor for the banks. Virtualization of banking services leads to electronic banking market intermediaries in a form of web portals.

Modern innovative solutions, speed and faultless acquisition and processing of information allow banks to obtain additional benefits and a good bargaining position in competition with other banks and financial institutions. The increasing use of modern solutions is also caused by rising customer requirements concerning the speed and quality of banking services reflected in the growth in the number of banking services performed outside building of the bank. It seems that the future of this institution will not be a large number of big institutions with many employees, but a bank in your home or office, supported by a network of automatic devices allowing to make most financial operations.

The use of modern technologies in banks' activities will increase productivity and performance. Automation of equipment and sales will increase the competitive strength of banks in order to improve the efficiency of its operations and create electronic distribution channels. A means to change the face of banking is omnipresent technology.

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Chapter 13
# Big Data in theoretical business informatics studies

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## Introduction

It is well known that every few years there is a new phenomenon in research that make a big impact on the direction of the studies for numerous researchers. In recent years we can observe a new approach in data processing and analysis that is called "Big Data". The goal of the article is to show Big Data approach from business informatics perspective. The article consists of fifth parts. In the second part there is a theoretical background of the Big Data research areas. In the third part there is a short cognitive study of Big Data implementation methods in theoretical studies of business informatics – including the review of articles that focus on Big Data in business informatics research areas. The fourth part presents feasibilities of Big Data approach in business informatics studies. Last part shows conclusions.

## 13.1. Theoretical background

Although the Big Data approach is known for several years there is no consensus on the definition yet. In several articles it is written that the term Big Data is too new to be defined consistently [Jackson, 2013]. The term Big Data has been used in research articles of almost every research domains, including computer science, healthcare and economics, concerning several topics, such as facilities in analysis of mass media, social networks and many others. Mostly it is referred to unstructured web data as it is not complicated to access and gather those types of data [Matsudaira, 2014].

Big Data is relevant not only to enterprises but also to researchers who have research data counted in petabytes [Stonebraker, Hong, 2012]. It's role is especially relevant in management research in which social network and unstructured data analysis is crucial [George et al., 2014].

Big Data is an abstract concept however the definition indicates Big Data as a large amount of data organized in a data set that is too large and so complicated, that it is difficult to manage and process the data using traditional technologies, such as relational database management system [Chen et al., 2014]. Researchers also define Big Data as the marketing banner that computer science community uses in their research agenda [Stonebraker, 2013]. However there are several definitions, of which well-known is:

Big Data are high-volume, high-velocity and (or) high-variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization [Gartner, 2012]. In some studies another attribute of Big Data is added – "high-veracity" [Courtney, 2013] or value.

In numerous articles Big Data is defined from the data perspective, for instance: "data is big when it's too big for conventional system to handle" [Gobble, 2013], "the term (Big Data – author) refers to the gigantic, complex data sets that are beyond the analytical capabilities of the IT tools available in most companies" [Jackson, 2013 based on McKinsey], "Big Data is (…) the overwhelming volume of information produced by and about human activity, made possible by the growing ubiquity of mobile devices, tracking tools, always-on sensors, and cheap computing storage" [Lewis et al., 2013]. Especially wide range of mobile devices makes a new role for mobile software, for instance in managing road infrastructure by collecting data on location of mobile phones [O'Leary, 2013]. However the decision of using Big Data to make analysis should be carefully regarded as it is not easy to assess whether Big Data should be used instead of traditional databases or data warehouses [Jacobs, 2009].

Based on the goal perspective, Scott Gnau from Teradata Labs said that the idea was to get Big Data analytics for the masses [Courtney, 2013].

With Big Data a new job has been widely introduced called data scientist for persons who have a skills and training for exploring data in large repositories [Davenport, Patil, 2012]. Based on the McKinsey reports, the demand for data scientists in the future will increase rapidly, as Big Data is growing very fast [Santaferraro, 2012]. Big Data allows accessing large datasets and process them using existing technology such as cloud computing in Software as a Service approach which makes it more useful for potential users [Allen et al., 2012]. Big Data also created a new executive called Chief Data Officer (CDO) who is responsible for defining strategy in the area of data [Lee, Stuart et al., 2014].

The aim of using Big Data approach is mostly to maintain the data that are usually unstructured. This is the necessity that comes from the value of the data gathered by web servers on the Internet. It is hard to estimate how many valuable data comes from the Internet in unstructured way, and how many in structured forms. But for sure the size of the data that comes from the Internet will be increased faster than structured data. Please note that the increasing value of the unstructured data has been described in 2006 by W.H. Inmon in his article [Inmon, 2006]. Coming back to 2008 we can see the solution how to gather this type of data and integrate them together with structured data in the data warehouse [Inmon et al., 2008]. However, integrating unstructured data with data warehouses can be limited to save results from Big Data analysis.

Although it is not obvious, organizations that implement Big Data will mostly use data-driven approach to make analysis [Church, Dutta, 2013].

To conclude it can be said that lots of articles contain the Big Data definition that focus on data perspective. Although there is no consistent definition, there are some attributes that are repeated in several studies. These are three V's based on Gartner (volume, velocity, variety).

## 13.2. Big Data appliances in theoretical studies

In this part of the article there are results of the analysis of research papers on Big Data, especially in the context of business informatics. Table 13.1 shows quantity analysis on the number of articles related to Big Data indexed by one of the most popular business research database from EBSCOhost.

The number of articles per year related to Big Data has significantly increased in 2012. In the Table 13.2 there is a short analysis of the number of articles on Big Data from 2009 to 2014.

**Table 13.1.** Analysis of articles related to Big Data

| Database | Total number of articles | Number of reviewed scientific articles | Number of reviewed articles related to business informatics |
|---|---|---|---|
| Business Sources Complete (EBSCOhost) | 2606 | 462 | 89 |

Source: Own elaboration.

In EBSCOHost Business Source Complete the number of reviewed scientific articles has significantly increased 300% in 2012 and in the period of January to the end of April 2014 it is more than half of the number of articles in 2013 (636 compared to 1250 in 2013). It means that in 2014 the number of articles will at least doubled the result from 2013. It should be clarified that the word Big Data in the title of the article does not mean that the articles is related to the Big Data in the same way. As it was written in this paper in the part of the analysis of theoretical background of Big Data, there is no strict definition yet, therefore the articles differentiate in the way of Big Data perception.

**Table 13.2.** The number of articles on Big Data in the period of 2009–2014

| Database | Number of articles in year | | | | | |
|---|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| Business Sources Complete (only reviewed scientific articles) | 2 | 1 | 6 | 47 | 251 | 458 |
| Business Sources Complete (total number of articles) | 7 | 12 | 114 | 551 | 1250 | 1819 |

The second issue is to analyse the context of the articles related to Big Data. Looking into EbscoHost database in Business Source Complete there was 2606 results of the "Big Data" articles, of which 462 come from scientific journals.

Based on the UNECE [2014] data used in the process of Big Data analysis can be divided into three groups:
- human-sourced information (social networks),
- process-mediated data (traditional business systems and websites),
- machine-generated data (automated systems).

From business informatics perspective the articles related to the data generated by humans are the most crucial. Data on social networking usually refers to gather consumer preferences on specific issues. Although typical appliances of Big Data in business informatics does not refer to machine generated data (such as MCR – Mobile Call Records or other data generated by sensors), it does not mean that those data will not be included to provide business information. It means that those data are not crucial for business informatics. The classification of the data in terms of business informatics is presented below.

Based on the analysis of research papers listed above, Figure 13.1 presents the scope of business informatics in Big Data research.

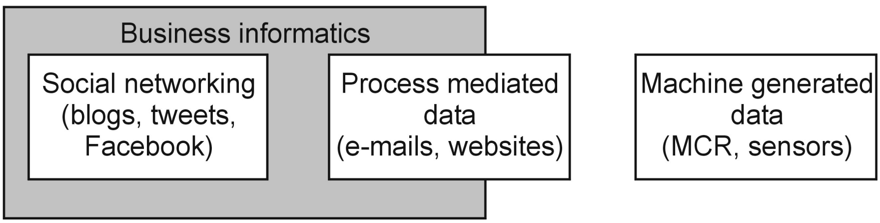


**Figure 13.1.** Business informatics covering area of Big Data sources

Source: Own elaboration.

Based on that analysis there are some essential sources for Big Data in business informatics:
- messages from social networks,
- websites content,

– results of Google search to provide information on user current preferences (like Google Trends).

## 13.3. Feasibilities of Big Data approach in business informatics

In this paper business informatics is referred to the research domains as well as to educational field of study at universities [Martz et al., 2011], also known as management information systems (MIS). The aim of the business informatics is to study IT appliances in business, which are mostly CRM and ERP systems, databases and related.

As written above, data in Big Data systems can be gathered from three sources: social networks, various business information systems and machine-generated data.

Based on the data perspective it can be written that vast stores of information can provide organizations endless insight on their business [Jackson, 2013]. Big Data can be used to offload expensive data warehouses to analyse market [Schroeder, 2009]. Big Data term in several papers is considered from Business Intelligence perspective which aim is also to make analysis on financial data [Hagel, 2013]. Finance data allow placing information in the context of market condition and changes in environment to produce relevant information for decision makers [Johnson, 2012]. In that way Big Data can be represented by Business Intelligence & Analytics 2.0 and 3.0 [Chen et al., 2012].

Although Big Data is also used widely in government sector, the way of using the data may be quite different as government datasets are sometimes called data silos because enormous amount of data is stored in legacy databases of each department [Kim et al., 2014].

This article focuses on business informatics perspective of the Big Data. How large amounts of data, usually unstructured can be used in business informatics?

As mentioned above, Big Data is very often related to healthcare, social networks – blogs, vlogs, wikis as well as gathering information from detection sensors. The basic question is – does Big Data affect the core of business informatics, which is business analytics, data warehouses or information systems such as ERP, CRM? To answer this question the analysis from the previous part of the article was used to make the following list of questions:

1. Do the organizations use or plan to use the streaming data that are not possible to analyse them in a traditional way (e.g., BI, DW)?

2. How many organizations use social networks to integrate the knowledge about potential customer's behaviour and preferences?

In large companies data is extracted from several sources including structured and unstructured data. Therefore Big Data in such companies is used to analyse log or text files, make video or voice analytics [Schultz, 2013].

In this article the possible answers to these questions were prepared based on three studies: observations and quick survey in a few organizations, secondary surveys that have results published on the Internet and the analysis of selected organizations strategy.

The first part shows us that there is no pressure on implementing Big Data approach in several organizations, as the traditional methods are used and they are sufficient to achieve the goal of the organizations strategy. It means that several organizations concern only reliable data and the way of gathering them (structured data) is enough to make a short analysis. Usually the scepticism from organizations is because of their lack of knowledge about future benefits from using the Big Data technology. However, please note that convincing the management staff to implement a new technology has always been a problem and is one of the essential parts of almost every implementation.

The second question, about using social networks in organizations, is not easy to answer as there are no reliable studies in that matter. By following the market trends organizations can use social networks just to observe the reaction of the society to new products. However, social networks is mostly used by young people, so the sample of the survey may not be representative if we don't know the age of the potential customers that write their opinion on their blogs, vlogs, Twitter and others.

The list of possible appliances of Big Data in business informatics research has been shown in Table 13.3.

The appliances listed in Table 13.3 are rather easy to implement having the current knowledge. Please not that methods listed in table are not new and were used mostly in the past (e.g., Text Mining). However Big Data gave new birth to such statistical and econometrical ways of analysing data.

**Table 13.3.** Possible methods of business informatics for Big Data analysis

| Methods | Description |
|---|---|
| A/B testing | To find better solutions for instance for an Internet shop by forwarding dozens of users to different types of the website. |
| Automated learning machines | To look into similar businesses on the Internet and analyse what type of products do they offer, including prices and special offers. |
| Keyword analysis (Map Reduce) | Analysis of consumer behaviour and their preferences based on the content of messages written on social networking. |
| Web mining and Text Mining | Analysis of the trends on current trends on the market including inflation based on price index. |
| Matching Keyword analysis | Searching Internet to find offers on business, e.g. for |

Typical environment used in such applications for business includes:

Apache Hadoop as the core of Big Data,

Apache Pig to write scripts in Pig Latin language using MapReduce algorithms,

Apache Hive – a data warehouse that may act like a business warehouse gathering the results of Big Data analysis,

NoSQL database to store the primary processed data.

This environment will be likely to use in most of the organizations as there are lots of business cases in the literature referred in this article.

## Conclusion

In this article we focused on the rather new phenomenon in IT which is Big Data, looking deeper into it from business informatics perspective. The goal of the article was to show the ways the Big Data can be applied in business informatics studies.

To conclude the following list of basic facts about the Big Data has been prepared:

1. There is no consensus on the definition, however it is usually defined based on IBM and Gartner as three V's – high-velocity, -volume, -variety.
2. Business informatics research domain has a key role in developing Big Data concept in the area of gathering business information based on social networks.

It author's opinion Big Data is not the concept to use it instead of existing ones, such as Data Warehouses or Business Intelligence systems. The issue of that concept is to provide new possibilities of analysing unstructured data or high-volume structured data that is not so easy to implement them by using traditional systems. As the role of the Internet in our society increases, the amount of unstructured information is increasing too. This leads to the conclusion that Big Data has a significant role in our life and will have a big impact on our lives in the future.

The following ways of using Big Data from business informatics perspective are mostly referred to social network analysis to find consumer preferences and current trends. However, what has been written in the fourth part of the paper, the area of business informatics in Big Data covers also analysis of websites, e-mails by using well known statistical methods such as Web or Text Mining.

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## Abbreviations

BI – Business Intelligence
CRM – Customer Relationship Management
DW – Data Warehouse
ERCIS – European Research Center for Information Systems
ERP – Enterprise Resource Planning
MIS – Management Information Systems
IBM – International Business Machine Corporation
IT – Information Technology

Chapter 14
# Measuring bank branch sales performance improvement driven by CRM system

*Andrzej Sieradz, Bernard F. Kubiak*

## Introduction

Data Envelopment Analysis (DEA) is a method for performance analysis and modeling of the organization and operational processes. DEA is a nonparametric and deterministic method, based on non-linear programming. In banking sector method is used for effectiveness measure of both bank branches and the banks, as companies. In this paper Malmquist Index (MI) has been used for branch benchmarking based on the concept of DEA efficiency score. DEA models used for Malmquist Index calculation can be oriented on input or output. When MI is output-oriented, determined current levels of inputs, in the case of orientation MI for inputs determined levels of inputs have to be established. Malmquist Index can be decomposed into two elements, first related to changing technological frontier and second related to efficiency of the objects (bank branches in this paper). MI enables the measurement of 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. The increase in "self-efficiency" of the object is associated with improved own capacity and performance. Some measured objects from whole population (in this paper – bank branches) are able to use more efficiently existing technology. This growth can be link with such factors as changes in individual productivity, improved learning or skills. The latest enterprise software forecast from Gartner[1] shows Customer Relationship Management (CRM) increasing to a $36.5 billion worldwide market by 2017. CRM also leads all enterprise software categories in projected growth, showing a 15.1% CAGR from 2012 to 2017, also revised up from 9.7% in the Q1 forecast in 2015.

The latest round of forecasts published in the report[2], shows CRM eclipsing ERP in worldwide market size in 2017. Figure 14.1, (see Appendix A) compares the relative growth of CRM, ERP, Business Intelligence (BI), Supply Chain Management and Web Conferencing, Collaboration/Social Software Suites.

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[1] Louis Columbus, www.forbes.com/sites/louiscolubus/2013/06/18/Grardner, accessed: 23.01.2015.

[2] Gartner Forecast: Enterprise Software Markets. Worldwide. 2012–2017.

## 14.1. Objectives of research and hypotheses

Most people involved in research or practically using CRM solution would probably agree that IT platform play essential role for CRM solution in the organization. Similarly most managers would agree with the statement that IT solution within CRM systems contribute to higher level of sales forces productivity and better customer maintenance. This positive impact of CRM has been addressed in many studies, just mention few of them [Avlonitis, Panagopoulos, 2005; Tellefsen, Thomas, 2005]. There have been also a number of attempts to identify success factors (SF) for sales force automation programs [Abdullah et al., 2000; Fjermestad et al., 2003; Jutla et al., 2001; Ocker, Mudambi, 2003], only few can provide theoretical or statistical support for the existence of SF. This may be because of the exploratory nature of these studies. As such they deal more with the potential than the reality of CRM's impact. Hence, full-scale research conducted in a highly scientific manner must be undertaken.

To fill this gap various articles and empirical research on marketing and IT were studied. The findings of these studies identified three types of factors that have a direct impact on successful implementation of the CRM. Model, definitions, techniques and discussion on these factors and how could they affect the effectiveness of the relation-ship and marketing objectives are described in the following sections. Objective for this paper should be treated as attempt to focus on specific areas CRM implementation rather than more macro-level consideration. Our research is centered on operational part of CRM and, more specifically, on very tangible element of measuring how sales force of the bank adopts IT technology that supports the customer-interacting aspects of the firm. That means overall technology which includes sales force automation tools pertaining to lead management, opportunity management and customer-contact management.

We define "IT acceptance" by only few parameters (easy to measure) as the degree which a sales advisor integrates IT tools into day by day activities. This concept is allows to understand by managers how frequency of technology usage and the full usage of the applications' capabilities are leading to better performance.

A goal of this paper study of efficiency is to assess the overall increase productivity of banks branches in the period just after CRM implementation. It should be noted that proposed model of measurement is directly linked to the objectives of CRM implementation which will be described in the following section. The second objective of the study is to propose a relatively simple model for the assessment of branch banks in terms of asset growth and productivity gain.

Taking under consideration the nature of this problem, we needed a tool that will satisfy the multi-dimensional nature of the overall business advisors performance evaluation challenge. Although using basics of DEA concept to evaluate performance over time is an uncommon application of DEA in this field, but we choose DEA because:

1. DEA is multi-dimensional in the sense that it can handle multiple outputs (business performance metrics) and multiple inputs. This factor is critical from a business advisors perspective, since the sales people in the branches usually face multiple performance targets, as well as multiple input parameters.
2. DEA produces a single efficiency score to indicate the efficiency of every branch in producing outputs (predefined), given the non-restricted input parameters.
3. Since, as a client company, we don't know too much about the outsourcing destination's internal processes, we needed a tool that will be fair to the outsourcing destination in the sense that it gives the highest possible efficiency score given any "weights" assigned to inputs. This is equivalent to letting the outsourcing destination management team defend themselves and build their argument around which inputs they think had the most effect on performance output. As inaccurate as it might seem, this option is very useful when you have little knowledge of internal operations because it gives the benefit of doubt.
4. It is also fair in the sense that it is data-sensitive, which means it doesn't compare DMUs performance to an absolute optimum or a benchmark; it compares the DMUs to other efficient DMUs. This basically means that the client is comparing the outsourcing destination's performance to its best-self. This is also very useful, when you have little knowledge of the industry, for example, the client doesn't know what is the fair increase in service level that should come from adding 3 more employees or reducing call volume by 20%
5. Last but not least, DEA is a very simple technique to learn and apply, which is very useful for a client's non-technical needs.

The decision to use in this paper DEA model and Malmquist Index has a double justification. Malmquist Index enables the analysis of a bank's branches performance measures against the others, so is natural benchmarking tool within the bank. On the other hand, a comparison to the previous period, which could be treated as month, quarters or full year, is "forcing" on the examined object to compare "to himself".

At this particular scheme all bank branches use the same technology, so the progress is manly done due to the individual effort. 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.

Based on the preceding discussion, we propose the following hypotheses:

1. **H1**: The efficiency bank advisors equipped in CRM system improves sales over the time.
2. **H2**: Overall performance of the bank branches improves (in the sense of MI measure).

## 14.2. Method

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.

We need to exercise due care in selecting an appropriate Return-to-Scale type. This problem exist is most DEA applications, since this method is data-oriented and non-parametric method. If the data set includes numeric values with a large difference in magnitude within the group of objects, (in this paper comparing big branches with small ones, objects in different micro-market conditions), the Variable-Return-of-Scale model may be a choice. However, if the data set consists of normalized numbers, e.g., per capita acre and hour, the Constants-Return-to-Scale model might be more appropriate candidate. In this paper we use both models and compare them.

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 branch network come from its versatility in the analysis of complex 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 so in such cases one can focus on macro results. A special case of the relative efficiency analysis for a single observed bank is to compare and analyse the efficiency ratio observed for two consecutive periods, usually annual.

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

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

In most models of DEA, the best performers share the full efficient status denoted by the score normalized to 1, and, from experience, we know that multiply object usually have this "efficient" status. The Super-efficiency model discriminates between this efficient Decision Making Units (DMU). The basic idea is that we delete the efficient DMU concerned from the production possibility set (PPS) and measure the distance from the DMU to the remaining PPS. If the distance is small, the super-efficiency of the DMU is judged to be lower as the DMU only marginally outperforms other DMUs. On the other hand, if the distance is large, the super-efficiency of the DMU is high compared with the remaining DMUs. Hence, it will make sense to rank the efficient DMUs in the order of the distance thus obtained. In our "Super-efficiency model," we utilize the slacks-based measure (SBM) of efficiency as defined in [Cooper et al., 2007, p. 99–104].

In most models of DEA, the best performers share the full efficient status denoted by the score unity (1), and, from experience, we know that plural DMUs usually have this "efficient" status. The Super-efficiency model discriminates between these efficient DMUs. The basic idea is that we delete the efficient DMU concerned from the production possibility set (PPS) and measure the distance from the DMU to the remaining PPS. If the distance is small, the super-efficiency of the DMU is judged to be lower as the DMU only marginally outperforms other DMUs. On the other hand, if the distance is large, the super-efficiency of the DMU is high compared with the remaining DMUs. Hence, it will make sense to rank the efficient DMUs in the order of the distance thus obtained. In our "Super-efficiency model," we utilize the slacks-based measure (SBM) of efficiency as defined on [Cooper et al., 2007, p. 310–319].

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 Malmquist Index evaluates the productivity change of a DMU (Decision Making Units[5]) between two time periods and is an example in "comparative statics" analysis. It is defined as the product of *Catch-up* and *Frontier-shift* terms. The catch up (or recovery) term relates to the degree to which a DMU improves or worsens its efficiency, while the frontier-shift (or innovation) term reflects the change in the efficient frontiers between the two time periods.

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.

[5] It should be mention that from classical requirements for DEA method point of view bank branches does not exercise full freedom in setting sales targets.

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.

The original version of the Malmquist Index assumed that DMU (bank branches in this paper) to be tested, moving on the lines which represent their production capacity, shown in Figure 14.1[6]. 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.

MI 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), ie 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.

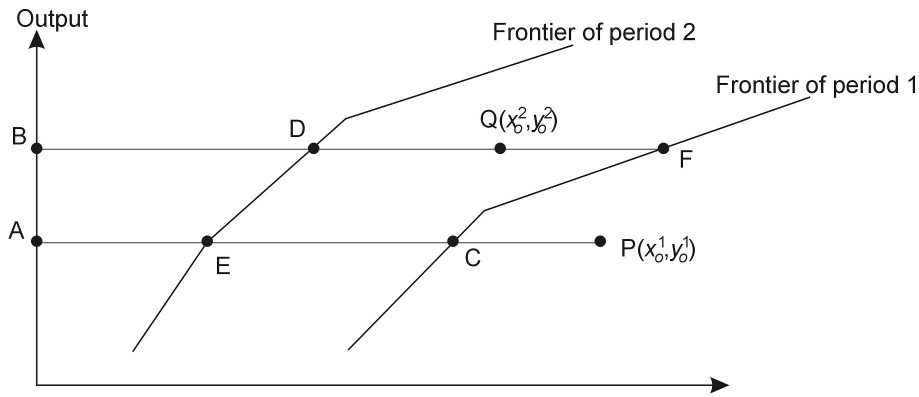



**Figure 14.1.** Graphical illustration Malmquist Index definition
Source : [Cooper et al., 2007, p. 329].

Q factor Malmquist for object shown in Figure 14.1 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:

6 Complete description of the model: [Cooper et al., 2007, p. 328–345).

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

(Catch-up) > 1 indicates progress in relative efficiency from period 1 to 2,
(Catch-up) = 1 Catch – up 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 $(x_o^1, y_o^1)$ moved to E on the frontier of period 2. Furthermore the frontier-shift effect at C $(x_o^1, y_o^1)$ is evaluated by:

$$\varnothing_1 = \frac{\text{Efficiency of } (x_o^1, y_o^1) \text{ with respect to period 1 frontier}}{\text{Efficiency of } (x_o^1, y_o^1) \text{ with respect to period 2 frontier}} \tag{2}$$

The denominator is measured as the distance from the period 2 production possibility set to C $(x_o^1, y_o^1)$

Likewise, the Frontier-shift effect at $(x_o^2, y_o^2)$ is expressed by the frontier-shift effect is described as:

$$\varnothing_2 = \frac{\frac{BF}{BQ}}{\frac{BD}{BQ}} = \frac{\text{Efficiency of } (x_o^2, y_o^2) \text{ with respect to period 1 frontier}}{\text{Efficiency of } (x_o^2, y_o^2) \text{ with respect to period 2 frontier}} \tag{3}$$

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

$$\text{Frontier-shift} = \varnothing = \sqrt{\varnothing_1 \varnothing_2} \tag{4}$$

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

$$\text{Malmquist Index} = (\text{Catch-up}) \times (\text{Frontier-shift}) \tag{5}$$

It is an index representing Total Productivity Factor (TPF) 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 paper results are presented based on non-radial Malmquist model input oriented with constant return of scale assumption.

## 14.3. Sample and data collection

The data to test the effectiveness of bank branches has been adopted from one of the universal banks in Poland. The main declare goal of implantation was to provide to the sales people 360 degree of customer view and to improve sales companies in terms of quantity and quality. It has been collected from the CRM by automatic measure of the parameters used in the model. In order to have obtained baseline for the measure, data has been collected from the “day one” of the CRM system, being in the production stage. In order to ensure the condition of homogeneity of the group, the study included bank branches in two separate groups (small and big branches) according to the organizational structure of the bank network. Total number of records –2244.

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

Malmquist Index was calculated based on the CCR[7] 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, 1995b], which shows that the variables create economies of scale factor Malmquist inadequate size.

The effectiveness of the bank branches was examined by adopting the following inputs and outputs:

Inputs:
- Summary of time spend in CRM systems (Login)
- Sales leads accomplished within the MBO[8] period (Sales leads)

Outputs:
- Assets
- Gross Profit and Loss Result in the period

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

[7] CCR model name comes from the names of the authors of this model (Charnes, Cooper, Rhodes).
[8] MBO – Management Business Objectives.

The correlation matrix shows (Table 14.1) a moderate positive correlation between variables chosen for the evaluation model. The other important relationship to highlight is the negative correlation or very small correlation between variables “Errors_manual”, “Errors_missed”, and reminding set of variables, which not expected. Business advisors should have care enough for data quality; nevertheless it is not correlated with Income or Assets level.

**Table 14.1.** Correlation of used parameters

| | **Assets** | **Income** | **Login Time** | **Sales** | **Errors_ manual** | **Errors_ missed** |
|---|---|---|---|---|---|---|
| Assets | 1,000 | | | | | |
| Income | 0,931 | 1,000 | | | | |
| Login Time | 0,771 | 0,882 | 1,000 | | | |
| Sales | 0,694 | 0,813 | 0,819 | 1,000 | | |
| Errors_manual | 0,029 | 0,000 | -0,035 | -0,007 | 1,000 | |
| Errors_missed | 0,321 | 0,376 | 0,371 | 0,327 | 0,305 | 1,000 |

| **Spearman Correlation** | **Assecs** | **Income** | **Login time** | **Sales** |
|---|---|---|---|---|
| Assecs | 1.000 | | | |
| Income | 0,92 | 1,00 | | |
| Login time | 0,75 | 0,78 | 1,00 | |
| Sales | 0,74 | 0,81 | 0,74 | 1,00 |

Source: Own calculation.

The reason we considered using regression analysis was that its data driven nature, which will allow it to be much more practical than the previous analytics tool in the sense that it uses data to estimate a model that would set the expectations for bank under evaluation. We used data (2244 records) to evaluate aggregate overall performance using regression over the period of 6 quarters for both small and big branches. As one can see in Table 14.2 the value of R-squared is 0.94.

**Table 14.2.** Regression Analysis – dependent variable – Income

. regress Income Assets Login
Sales_Targets

| Source | SS | df | MS |
|---|---|---|---|
| Model | 1.3799e+15 | 3 | 4.5998e+14 |
| Residual | 8.5409e+13 | 2240 | 3.8129e+10 |
| Total | 1.4653e+15 | 2243 | 6.5329e+11 |

| | | |
|---|---|---|
| Number of obs | = | 2244 |
| F(3,2240) | = | 12063.66 |
| Prob > F | = | 0.0000 |
| R-squared | = | 0.9417 |
| Adj R-squared | = | 0.9416 |
| Root MSE | = | 2.0e+05 |

| Income | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| Assets | .0056409 | .0000772 | 73.06 | 0.000 | .0054895 | .0057923 |
| Login | 810.3991 | 28.7667 | 28.17 | 0.000 | 753.9869 | 866.8113 |
| Sales_Targets | 107.12 | 5.866232 | 18.26 | 0.000 | 95.61619 | 118.6238 |
| _cons | −58518.11 | 7326.779 | −7.99 | 0.000 | −72996.1 | −44150.12 |

Source: Own calculation (STATA 13).

The results and outcome – values of efficiency in sense of DEA model (S_SBM_O_V) are presented in Table 14.3. Technical efficiency of branches was improving in the first four quarters and drop in the last one. The average of technical efficiency ratio during this period was rising as well as values in the separate quartiles.

**Table 14.3.** Values of efficiency in model S_SBM_O_V

| **Super SBM_O_V (Big branches)** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** |
|---|---|---|---|---|---|
| | | | | | |
| Avarage | 0,46 | 0,48 | 0,51 | 0,54 | 0,52 |
| | | | | | |
| Median | 0,39 | 0,42 | 0,45 | 0,49 | 0,47 |
| | | | | | |
| quartile 1 | 0,30 | 0,31 | 0,36 | 0,36 | 0,36 |
| quartile 2 | 0,39 | 0,41 | 0,45 | 0,48 | 0,48 |
| quartile 3 | 0,54 | 0,54 | 0,56 | 0,59 | 0,59 |
| quartile 4 | 1,48 | 1,33 | 1,43 | 1,51 | 1,51 |

Source: Own calculation (DEA Solver Pro – ver.7.0).

In the Table 14.4 the summary of the data sample for group of "big" branches has been presented. As easily be seen, (the number of increases in the MI value) has been rising for the first 3 quarters and declined in the last 2 quarters of measured period. That can be further analysed in order to determine the overall causes outside of bank[9].

**Table 14.4.** Summary of sample for "big branches"

| | | | | | |
|---|---|---|---|---|---|
| Average (Big branch O_V | 0.68 | 0.93 | 1.34 | 1.10 | 0.93 |
| Max | 1.19 | 4.13 | 2.84 | 1.21 | 1.45 |
| Min | 0.14 | 0.35 | 0.30 | 0.20 | 0.75 |
| SD | 0.17 | 0.35 | 0.35 | 0.20 | 0.08 |
| Number of increases | 2 | 30 | 110 | 7 | |
| | | | | | |
| Average (Big branch O_C) | 0.68 | 0.91 | 1.31 | 1.12 | 0.92 |
| Max | 1.20 | 1.45 | 1.96 | 1.43 | 1.12 |
| Min | 0.21 | 0.40 | 0.78 | 0.36 | 0.77 |
| SD | 0.17 | 0.17 | 0.26 | 0.17 | 0.06 |
| Number of increases | 4 | 35 | 103 | 9 | |

Source: Own calculation.

In the Figures 14.3, 14.4, 14.5 the envelope of results whole group has been presented for the constants and variable scale of return. The difference are no significant, nevertheless the better discrimination ability of the model S_SBM_O_V make it more recommended. As one might expect the "Catch-up" results are stable over the period of time and the only difference in final value of Malmquist Index is coming from the "Frontier-shift".

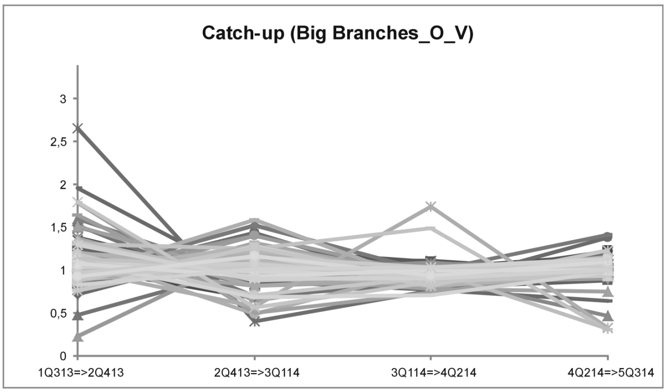



**Figure 14.2.** Index "Catch Up" for efficiency of big bank branches

Source: Own calculation.

[9] One of the reasons might be the decrease of interest rates by 50 basic points, which decrease the level of income for whole sector.

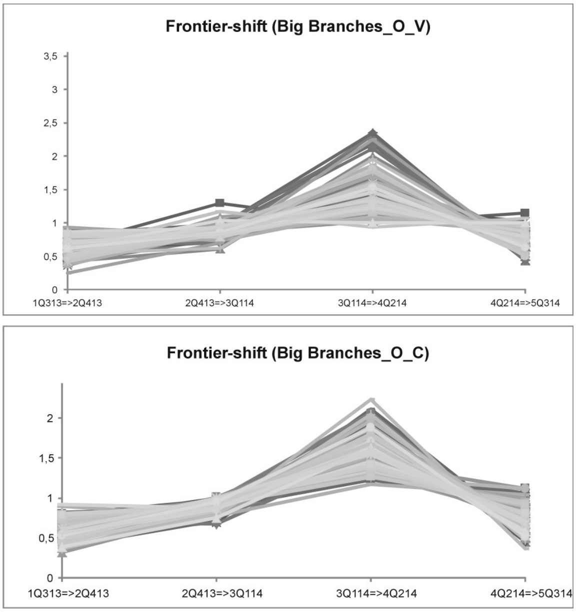



**Figure 14.3.** Index “Frontier-shift” for efficiency of big banks

Source: Own calculation.

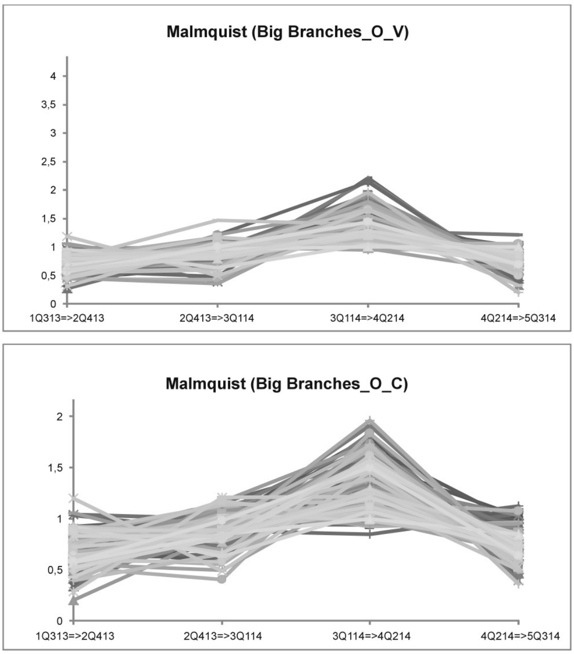
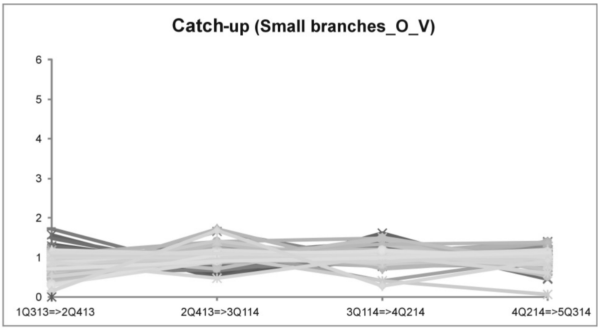



**Figure 14.4.** Malmquist Index for big bank efficiency

Source: Own calculation.



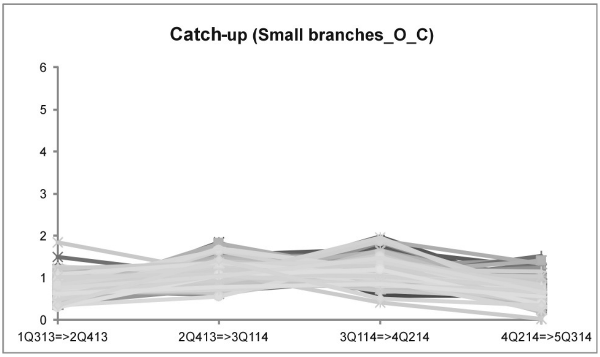




**Figure 14.5.** Index "Catch Up" for small bank branches

Source: Own calculation.

Similarly in Table 14.5 the summary of the data sample for group of "small" branches has been presented. As before in case of "big" branches one can see, that (the number of increases in the MI value) has been rising for the first 3 quarters and declined in the last 2 quarters of measured period.

**Table 14.5.** Summary of sample for "small branches"

| | | | | | |
|---|---|---|---|---|---|
| Average (Small_O_V) | 0.76 | 0.94 | 1.23 | 1.10 | 1.20 |
| Max | 3.61 | 4.52 | 3.52 | 2.95 | 2.17 |
| Min | 0.10 | 0.31 | 0.30 | 0.07 | 0.56 |
| SD | 0.31 | 0.32 | 0.36 | 0.20 | 0.14 |
| Incresed efficiency | 40 | 66 | 232 | 96 | |
| | | | | | |
| Average (Small_OC) | 0.62 | 0.85 | 1.34 | 1.02 | 1.10 |
| Max | 4.80 | 2.65 | 4.22 | 4.66 | 2.58 |
| Min | 0.14 | 0.39 | 0.45 | 0.06 | 0.55 |
| SD | 0.34 | 0.24 | 0.40 | 0.39 | 0.18 |
| Incresed efficiency | 15 | 53 | 221 | 124 | |

Source: Own calculation.

In the Figures 14.6, 14.7, 14.8 the envelope of results for whole group “small” branches has been presented for the constants and variable scale of return. Similarly to the “big” branches the difference are no significant, nevertheless the better discrimination ability of the model S_SBM_O_V make it more recommended. It is worth mentioning that dynamics in trend for “small” branches is lower than “big branches. The difference in final value of Malmquist Index is mostly driven by value of “Frontier-shift” component of MI.

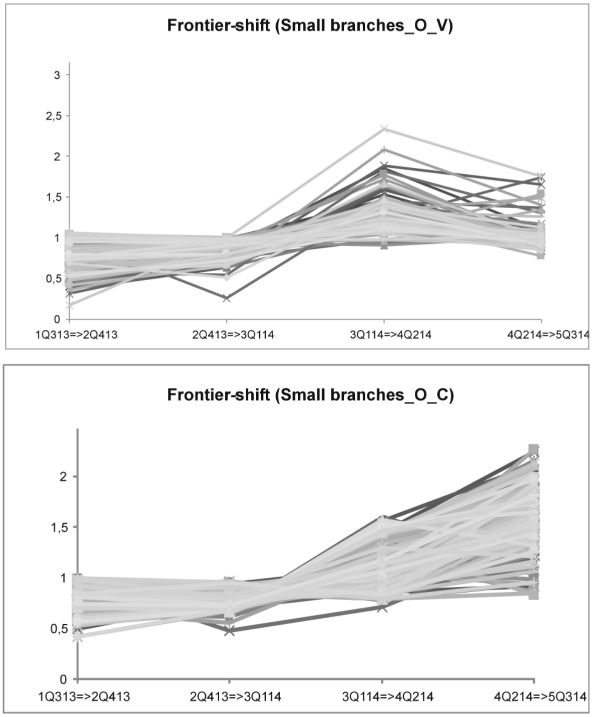



**Figure 14.6.** Index “Frontier-shift” for small branches

Source: Own calculation.

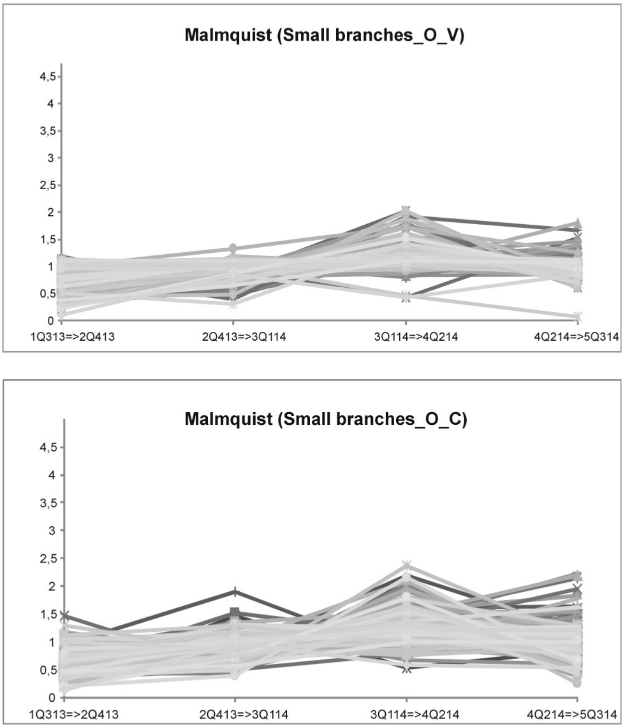



**Figure 14.7.** Malmquist Index for small branches

Source: Own calculation.

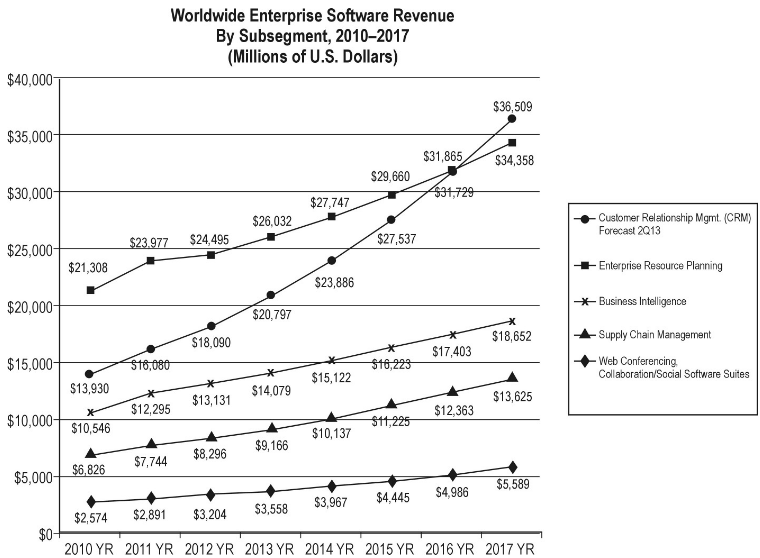



**Figure 14.8.** Software Revenue Forecast

Source: Annual Software Revenue Forecast Report – Gartner, 2014.

## Conclusion

This article presents the results of an empirical study of the link between the measures of bank branch sales performance and CRM information technology usage in one of the universal bank in the Polish sector. Bank branches as classical sales offices and we used for this purpose Super-SBM model of DEA and Malmquist Index. The efficiency bank advisors equipped in CRM system improves sales over the time.

A value of productivity index shows a linear relationship with the overall efficiency of banks. The coefficient of correlation between spending on IT efficiency and overall technical efficiency of banks for the period covered is 0.55. Future studies of the effectiveness of using the Malmquist Index to help determine the relationship between innovation banks (the introduction of new products and services or high technology) and the efficiency of their operation.

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Chapter 15
# Business rules automation standards in business process management systems

*Maciej Kiedrowicz, Robert Waszkowski*

## Introduction

The rapid growth of the IT market and of the related new technologies prompts companies to invest in IT systems that are continually upgraded and designed to accelerate, enhance and automate their corporate procedures. Therefore, numerous process modelling tools have been designed as an indispensable support to organizational development and one of the factors contributing to companies' competitive advantage and ability to succeed on the market. Recent years have seen a tendency to expand the architecture of corporate IT solutions by adding business rules management systems that facilitate the control of data flows in business process modelling, thereby reducing their complexity, improving process legibility and allowing for the multiple use of once modelled elements. Business rule editors may work as separate tools controlling all procedures throughout a company.

Business rules support workflow systems and business process management systems in respect of the description and application of pre-defined standard rules based on some measurable values of the process instances characteristics. The issue of business rules is reflected in the project financed by the National Centre for Research and Development "Electronic system of managing the life cycle of documents with multiple sensitivity levels".

## 15.1. Analysis of business rules edition in solutions available on the market

The business rules edition solutions offered on the market employ various engines supporting the application's logic. The absence of any real standards in this field has been a problem for a long time, since it prevents the wide application of business rules and the exchange of business rules across different tools. Below described are methods used for business rules representation and standards employed by companies to a greater or lesser extent when developing dedicated engines or used in the existing IT projects, e.g. in a Drools library.

Each of the standards described may be placed within one of the Model Driven Architecture layers, which illustrates the software design approach based on models and their transformations. The following layers can be distinguished:

- Computation Independent Model (CIM) is a business model where the scope of software responsibility is not specified precisely.
- Platform Independent Model (PIM), where modelling is platform independent and the system's logical perspective is described. This may be referred to as an abstract specification of the system.
- Platform Specific Model (PSM) is a model mapped into selected solutions of a specific platform.

The standards described hereunder are located in one of these layers (Figure 15.1). Presentation Rule Representation (PRR) and Rules Interchange Format (RIF) are located in PIM. Semantics of Business Vocabulary and Business Rules (SBVR) are at CIM level, i.e. the model abstracting from both hardware and software. JSR is situated in PSM.

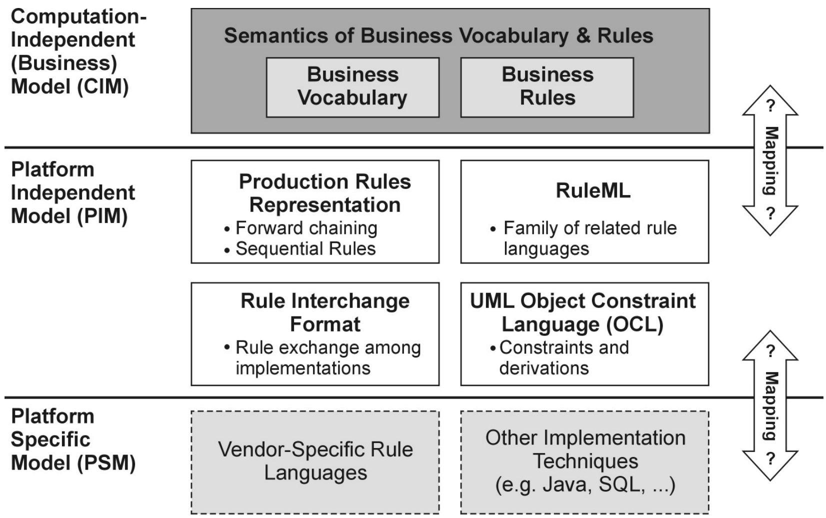


**Figure 15.1.** Model Driven Architecture layers

Source: [http://ai.ia.agh.edu.pl/wiki/].

## 15.2. An overview of standards

### 15.2.1. Standard PRR (Production Rule Representation)

Object Management Group (OMG) has introduced its own standard named Production Rule Representation [Documentation of the PRR, 2015]. Here, rules can be represented in UML. The production rule is defined as a programmable logic instruction defining the execution of one or many actions under certain pre-defined conditions. It can be represented as: if [condition] then [list of actions]. Production rules are illustrated in the classification graph (Figure 15.2) as one of the business rules categories (classification provided by RuleML Initiative). This form of knowledge representation is used by various business rules edition tools.

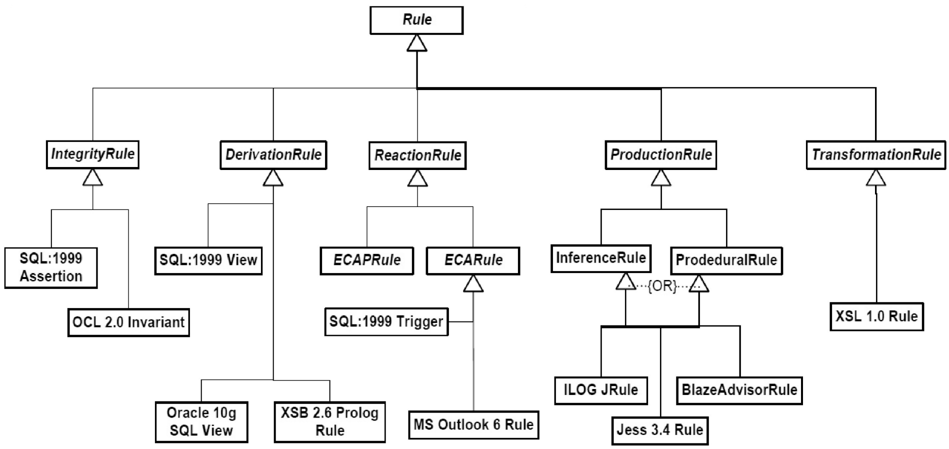


**Figure 15.2.** Classification of rules provided by R

Source: [http://www.edmblog.com/weblog/PRRCore.pdf].

The PRR standard provides a metamodel for rules (Figure 15.3), but it does not specify the syntax in detail. Although the specification of 2007 introduces PRR OCL – Production Rule Representation Object Constraint Language – used for defining business rules and supported by OCL, which is a part of the UML notation, this form is not made compulsory however, while examples are also given in PRR OCL, as well as by means of a production rules syntax resembling Java. An exemplary business rule in PRR OCL notation might look as follows [Documentation of the PRR, 2015]:

```
ruleset ruleset3(in company : Company) :

variable: parisCustomer : List = Utils.createList();

rule r1
ruleVariable:
   customer : Customer = company.customers-> any();
   addresses : Set = customer.addresses->select(p:Address |
p. city
   ='Paris');
condition:
   addresses.size()> 0 and not parisCust.contains(customer);
action:
   parisCustomer.add(customer);

rule r2
ruleVariable:
   customer : Customer = company.customers-> any();
   addresses : Set = customer.addresses->select(p:Address |
   p. city= 'Paris');
condition:
   addresses.size() = 0 and parisCust.contains(customer);
action:
   parisCustomer.remove(customer);

rule r3
condition:
   parisCustomer.size() = 0;
action:
   Utils.sendMessage("There is no customer of company with an
   address in Paris");
```

Rules r1 and r2 obtain a list of customers who specified at least one address in Paris in the process of registration. Under the first rule, if the condition is satisfied, the individual is added to the list of customers from Paris, while in the second rule the individual is deleted from this list if no address in Paris has been assigned yet. The last rule verifies if the list includes any customers from this city. If no, a message is sent accordingly. The syntax is very simple and self-explanatory here. After rule the name of the rule is specified; variables are defined in the ruleVariable section; condition is followed by the clause specifying the condition to be satisfied if the action is to be executed. Rules are grouped in the ruleset.

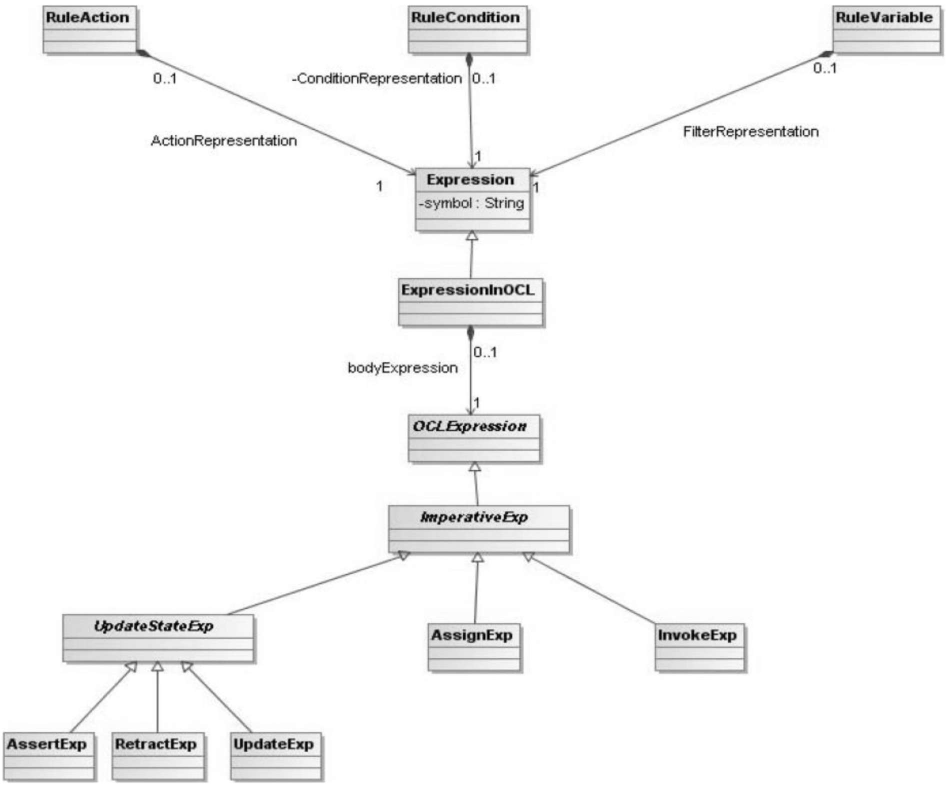


**Figure 15.3.** A metamodel for PRR OCL
Source: [http://www.edmblog.com/weblog/PRROCL.pdf].

The Production Rule Representation contains also a PRR Core subset, which comprises a set of classes that allow for production rules to be defined in a platform-independent way, without having to specify expressions in OCL. Representing business rules as conditions and actions, by means of a specific syntax, limits the ability to transform rules from one environment to another, while PRR Core allows for sharing of rules between all tools that "understand" the basic structure of production rules. Figure 15.4 shows a complete metamodel for the PRR Core standard, presenting classes used in the execution of production rules.

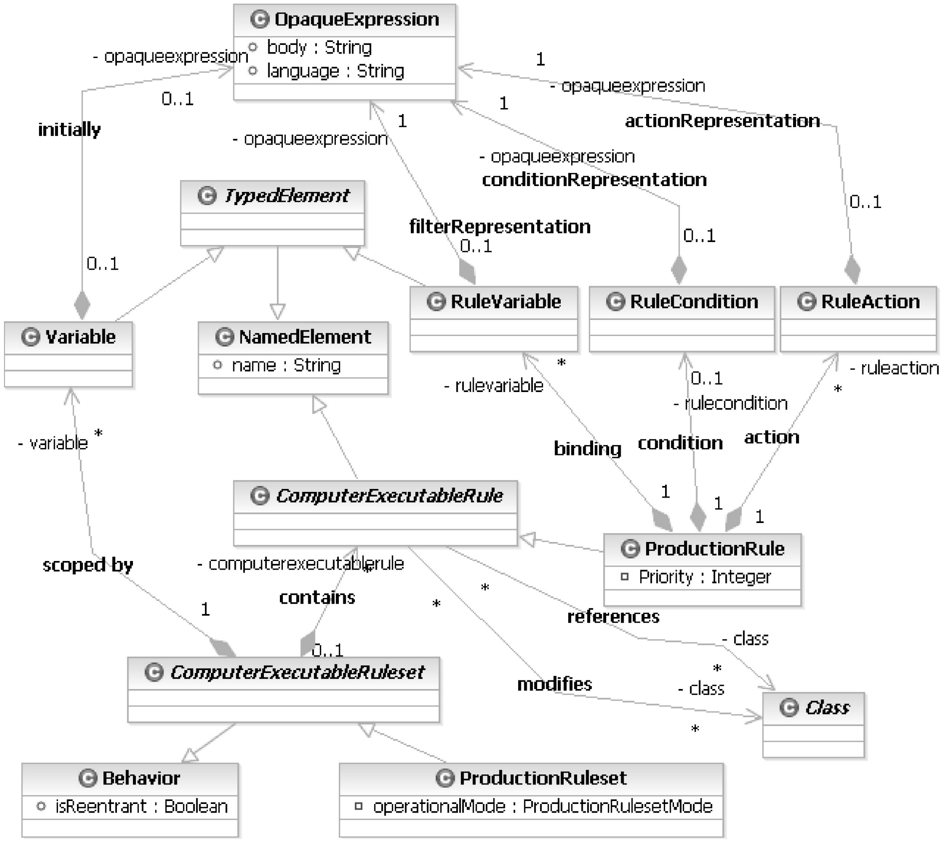


**Figure 15.4.** A metamodel for PRR Core

Source: [http://dmblog.fico.com/2007/06/production_rule.html].

## 15.2.2. Semantics of Business Vocabulary and Business Rules (SVBR)

Semantics of Business Vocabulary and Business Rules (SBVR), a standard approved by Object Management Group (OMG), provides various methods for defining business objects and rules by means of a formalized natural language. The SBVR specification is used for describing models independent of the platform on which they are deployed. It presents the structural aspect of processes and provides a basis for defining vocabularies that may be used for describing any undertaking or concept in the organization. The official specification available from the OMG website is arranged into vocabularies [Documentation of the SBVR, 2015]:

- Registration Vocabulary,
- Logical Formulation of Semantic Vocabulary,
- Meaning and Representation Vocabulary,

– Formal Logic and Mathematic Vocabulary,
– Vocabulary for Describing Business Rules,
– Vocabulary for Describing Business Vocabularies.

The last two, labelled as Vocabularies and Terminology Dictionaries (Figure 15.5) are used for defining rules. Furthermore, SVBR defines two types of business rules: structural rules (discussed earlier when presenting static alethic categories) that express possibility and impossibility and operative behavioural rules (static deontic) that refer to obligations, prohibitions and permissions.

In SBVR, the whole idea (Figure 15.6) of business rules is derived from the statement that rules are based on facts and facts are built on noun concepts represented by terms – the most elementary elements in rules. A car, a client, etc. can be given as examples of such atomic terms. Facts are relations between these concepts. For example: an employee has to be insured. There are a few common ways of expressing facts and business rules in SBVR, namely through statements, diagrams or a combination of these two, depending on the purpose. A graphic notation is helpful in showing how concepts are interrelated, but impractical when a vocabulary needs to be defined. In SBVR rules can be denoted by means of logical symbols defined in the standard.  means necessity,  expresses possibility,  is an obligation,  – permissibility. Furthermore, SBVR provides also a language for presenting business rules: Structured English Representation, with the following syntax for denoting important elements: term – for a designation of a noun concept; Name – for a designation of an individual noun concept, a name; verb – a verb concept for a fact type designation; keyword – linguistic symbols used to construct statements and rules. Examples include logical operators (or, and), quantifications (exactly one, each).

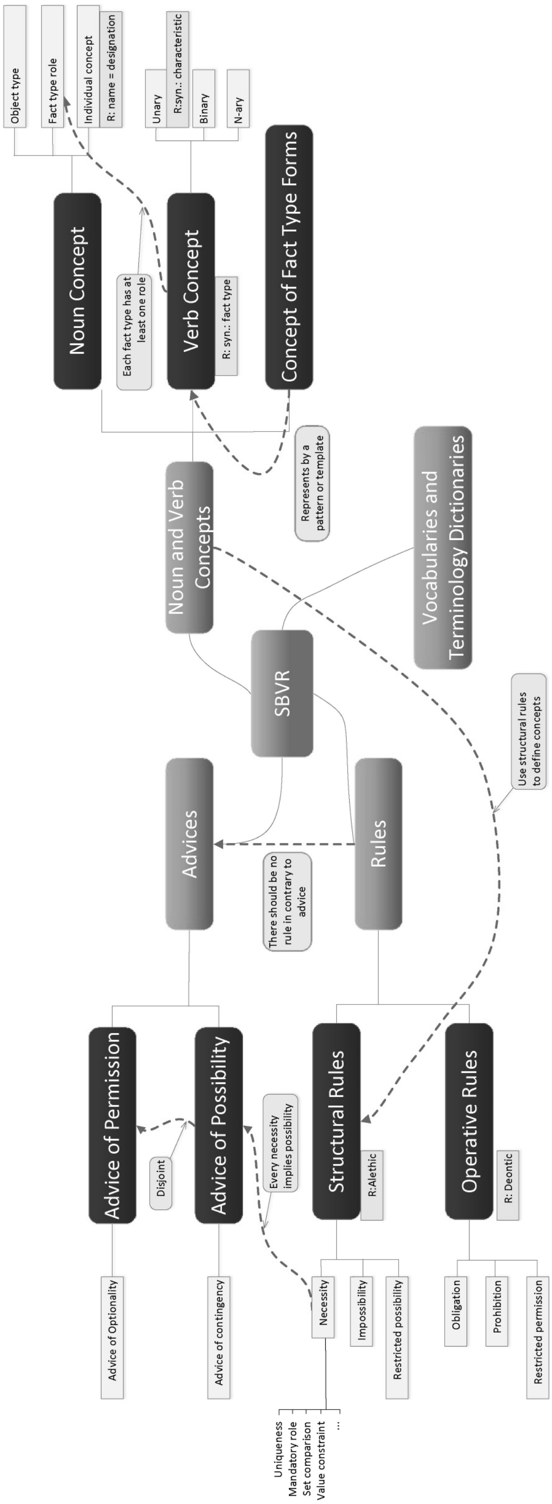


**Figure 15.5.** Business rules in the SBVR standard
Source: [http://www.omg.org/spec/SBVR/1.2/PDF/].

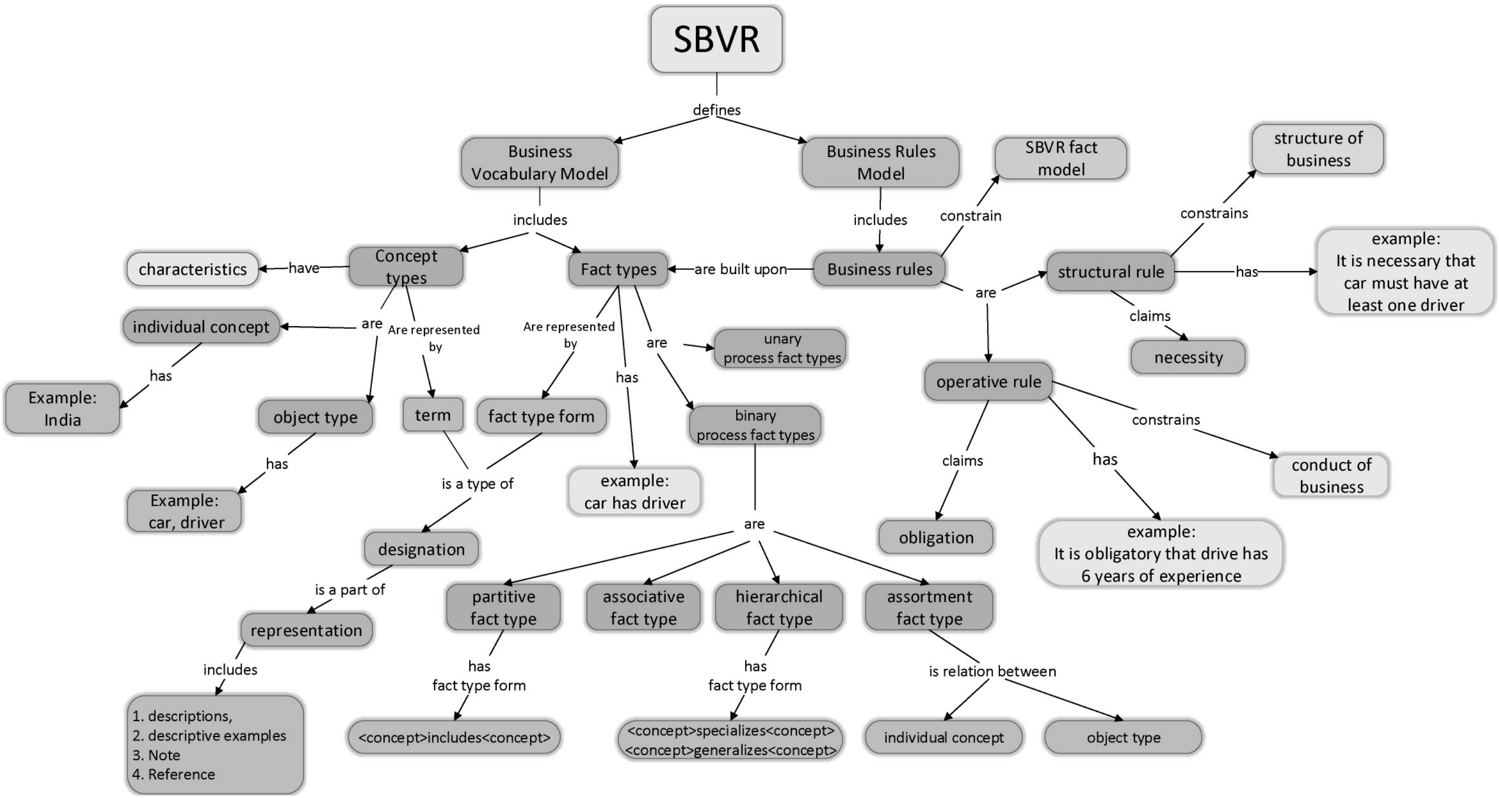


**Figure 15.6.** The SBVR standard structure

Source: [http://www.omg.org/spec/SBVR/1.2/PDF/].

### 15.2.3. Standard RIF (Rules Interchange Format)

Rules Interchange Format (RIF) [Documentation of the RIF, 2015] is a standard being developed by World Wide Web Consortium (W3C) with the aim of providing a specification for the exchange of business rules between different systems. Considering that the existing tools for expressing business rules offer a wide range of functions and differ not only in semantics but also – what is more important – semantically, the goal set for the RIF standard is not by any means easy. Figure 15.7 depicts a vision of RIF, where the standard is a set of dialects – an extensible set of languages with a strictly defined syntax and semantics.

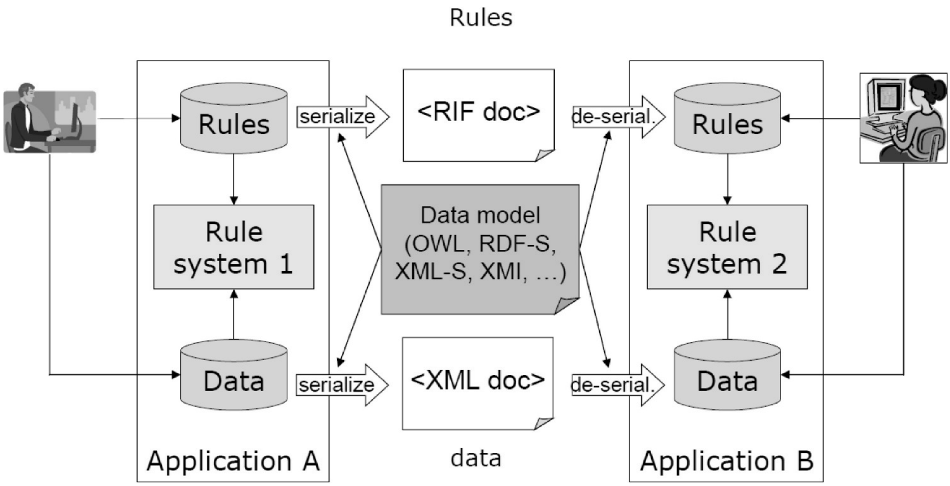


**Figure 15.7.** The essence of Rules Interchange Format
Source: [http://teaching-wiki.sti2.at/uploads/7/74/08_SW-RIF.pdf].

The idea behind the exchange of rules via RIF is that systems are capable of mapping their languages (or a significant part of these) to and from respective RIF dialects, with the same set of rules and data transferred to another application, providing that the dialect used is supported by both tools.

RIF consists of three types of dialogues, namely: the RIF Core, a subset of the Basic Logic Dialect (BLD) and the Production Rule Dialect (PRD), which supports Drools and Jess. The RIF architecture is determined by an extensive list of data and built-in functions, as well as predicates over them. Figure 15.8 illustrates interdependencies between RIF components.

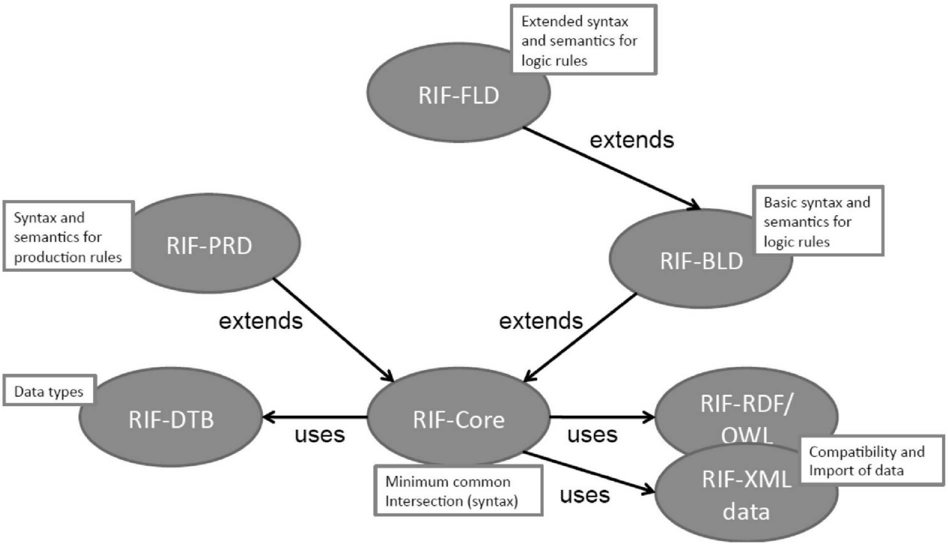


**Figure 15.8.** RIF standard architecture

Source: [http://teaching-wiki.sti2.at/uploads/7/74/08_SW-RIF.pdf].

Syntactically, RIF BLD has a number of extensions for supporting such functions as objects and frames in F-logic, as well as XML Schema datatypes, allowing for mapping the rules expressed in this dialect:

```
And (Exists ?Buyer (cpt:purchase(
          ?Buyer ?Seller
cpt:book(?Author bks:LeRif)
curr:USD(49)))
?Seller=?Author )
```

to XML format [Documentation of the RIF, 2015]:

```
<And>
<formula>
<Exists>
<declare><Var>Buyer</Var></declare>
<formula>
<Atom>
<op><Const type="&rif;iri">&cpt;purchase</Const></op>
<args ordered="yes">
<Var>Buyer</Var>
<Var>Seller</Var>
<Expr>
<op><Const type="&rif;iri">&cpt;book</Const></op>
<args ordered="yes">
<Var>Author</Var>
```

```
<Const type="&rif;iri">&bks;LeRif</Const>
</args>
</Expr>
<Expr>
<op><Const type="&rif;iri">&curr;USD</Const></op>
<args ordered="yes"><Const type="&xs;integer">49</Const></args>
</Expr>
</args>
</Atom>
</formula>
</Exists>
</formula>
<formula>
<Equal>
<left><Var>Seller</Var></left>
<right><Var>Author</Var></right>
</Equal>
</formula>
</And>
```

RIF PRD is a standard for exchanging production rules. It specifies an abstract syntax which shares properties of other languages defining the rules. A rule can be foe example expressed as follows [Documentation of the RIF, 2015]:

```
Forall ?customer ?purchasesYTD (
If And(?customer#ex:Customer
?customer[ex:purchasesYTD->?purchasesYTD]
External(pred:numeric-greater-than(?purchasesYTD 5000)))
Then Do(Modify(?customer[ex:status->"Gold"])))
```

As described in previous chapters, the production rule consists of the IF section where preconditions are defined and the THEN section, where a conclusion is specified. In RIF PRD, rules can be mutually interdependent, hence conflict solving strategies are required when many instances are triggered. PRD defines a solution based on forward chaining.

### 15.2.4. JSR-94

JSR-94 [Specyfikacja JSR-94, 2015] is a specification where the rules engine implementation has been standardized for Java technology. The standard is supported by Drools, Fair Isaac Blaze Advisor, Isaac Blaze Advisor and Jess – the most popular rule engines. JSR-94 provides guidelines for rule management and an execution environment, but it does not specify the language to be used for defining them. The specification offers rule registration, parsing and execution functions, as well as the retrieval and filtering of results. JSR-94 consists of two main packages: the Rules Administration API for business rules management and the Runtime Client API for running and getting the results. A structure like this reinforces the distinction between those who execute the rules and those who administer them.

## Conclusion

The idea to define business rules derives from the business process management concepts. The so-called Business Rules Manifesto is a source of knowledge about these problems. According to the Manifesto, business rules are statements defining or limiting a certain aspect of an organization. From the business perspective, the focus is on the behaviour and the actions of people in companies. From the system point of view, they address facts recorded in the IT system as data and constraints. Consequently, business rules express specific restrictions on the creation, updating and deleting data in the system.

The research has revealed that there is no single, common standard for business rules representation. The standards presented in the paper: PRR (Production Rule Representation), SVBR (Semantics of Business Vocabulary and Business Rules), RIF (Rules Interchange Format) and Specification JSR-94 are not compatible. Although they all demonstrate a certain degree of applicability to modelling rules for business purposes, a common, uniform standard for the business rules representation is needed.

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Chapter 16
# Security of information risks in state-run universities and colleges in Poland

*Jerzy Gwizdała*

## Introduction

Risk is involved in every activity, including the operations of universities and colleges (higher education institutions – HEIs); it is the natural consequence of their business operations. It is connected with making decisions, the outcome of which is foreseeable over a longer or shorter time. It frequently translates into success and gains, but sometimes into failure and losses. The success depends on the ability of the staff to adjust their teaching and research offer to the changing market, to generate benefits, both material and non-material at the time of boom in the market for educational services and to cope with the difficulties and failures. In the competitive market of educational services, we have to face hundreds of decisions to be made, which affect the risk volume and the ways of mitigating it. Risk means the possibility of events that will adversely affect the situation of the HEI – in various aspects of its activities. The level of risk varies depending on the school's mission, strategy and on the time scale.

Managing an HEI is not about a constant avoidance or a complete mitigation of risk. It is more about understanding the risk, the ability to measure it and, ultimately, manage it in a conscious way.

Operating under risk has a special place in the functioning of every HEI. In the educational services market, an HEI that does not grow steadily is hardly conceivable [Kumpiałowska, 2011, p. 34–35]. Furthermore, the proper risk management is based on the principle of trust and is a form of integrated management within the given HEI. If this rule is not observed, risk may easily accumulate, leading to the instability of the whole system of tertiary education. This is why risk in academic institutions has to be monitored and mitigated.

Risk management in state-run HEIs also involves the problems of the security of information, which is related to their functioning in the realities of EU red tape in its member states. The study of the problem has led to the identification of four stages in the process of information security risk management in higher education institutions:

– risk identification;
– risk quantification and analysis;

– risk control;
– risk monitoring.

The main purpose of this paper is to determine the role of information security in the operations of HEIs, the risk involved, the ways of mitigating it, and to formulate recommendations.

## 16.1. Legal and institutional setting of risk management

As publicly financed bodies, HEIs are now operating in the changing environment in terms of legal and institutional framework as well as social and economic conditions. The changes are largely dependent on institutional modifications and on the processes of regulatory globalisation and internationalisation, integration, information technology and advanced innovation processes. The processes just mentioned, coupled with the way in which they occur, frequently add to the risk that goes with the research and teaching activities of HEIs.

The risk management process is a multiphase phenomenon and a major, indispensable element of management control of an organisation. Whoever wants to manage the organisation – and its risk – effectively, must constantly analyse its changing macro- and micro-environments by identifying the risk involved and its origins and by measuring it. In view of the impact that can be generated by individual risks and their macroeconomic dimension, risk management in HEIs is getting increasingly relevant. This gives rise to the emergence of risk management models, guidelines, regulations and recommendations.

Internal control in higher education institutions comprises all the measures taken to ensure goal accomplishment in a way that is compliant with the laws, effective, economical and timely. Its main tasks are to:

– lay the foundations for effective management;
– provide the necessary information for management decisions;
– highlight the instances of non-compliance;
– prevent neglect, misappropriation, as well as other malpractice.

Internal control should, in particular, ensure:

– compliance with the existing laws and internal procedures;
– efficiency;
– credibility of reporting;
– protection of resources;
– observance and promotion of high ethical standards;
– effective communications;
– risk management.

The system of internal control of an HEI must be consistent with its legal and organisational setting, its resources – both human and financial – and is an integrated set of elements and factors.

The core of internal control is its credibility, meaning that the audits are performed in an objective, unbiased manner and their findings are a true picture of the audited events. The functioning of internal control in most Polish HEIs has been outlined within five areas of standards relevant for the elements of control:
- internal environment;
- goals and risk management;
- control mechanisms;
- information and communication;
- monitoring and evaluation.

The five areas of control standards presented above are a structured set of indications facilitating the development, the assessment and the steady improvement of the internal control system [Public Finance Law of 27 August 2009]

In view of the rapid growth of risk management as a discipline, efforts are being made to bring a certain order into it. This happens through the development of various risk management concepts, models and standards [Zapłata, Kaźmierczak, 2011, p. 91–94]. If HEI goals and tasks are to be made more viable, risk identification should be performed at least once a year, followed by risk description, analysis and assessment.

Major international risk management regulations include [Skoczylas, 2012, p. 711–712]:
- the Sarbanes-Oxley Act of 2002;
- the Enterprise Risk Management model (ERM) developed by COSO[1], often referred to as COSO II;
- International Accounting Standard 7;
- the Australia/New Zealand risk management standard of 2004, AS/NZS 4360:2004;
- the British risk management standard of 2002: Management of Risk – A Strategic Overview, commonly referred to as the Orange Book, jointly developed by The Institute of Risk Management (IRM), The Association of Insurance and Risk Managers (AIRMIC) and ALARM The National Forum for Risk Management in the Public Sector;
- Polish ISO-like standardising documents (PN-ISO/IEC 27005 *Technika informatyczna – Technika Bezpieczeństwa – Zarządzanie ryzykiem w bezpieczeństwie informacji*, PKN, Warszawa 2010).

[1] COSO – Committee of Sponsoring Organizations of the Treadway Commission.

The documents listed above are either an overall approach to risk management inside an organisation, e.g., Enterprise Risk Management – ERM developed by COSO, or address a specific criterion area, like the risk of public finance institutions or the security risk, e.g., ISO 27005.

International organisations have emerged, too, grouping risk management theorists and practitioners, of which the following should be mentioned:

- The Professional Risk Managers International Association (PRMIA);
- The Global Association of Risk Professionals (GARP);
- The Society for Risk Analysis (SRA);
- The Federation of Enterprise Risk Management Associations (FERMA).

In addition to risk management standards, the literature of the subject deals with various risk management models, while risk management is also the subject of regulation in many countries. The Polish public finance sector may be an example here, to which risk management was introduced by the 30 June 2006 communication of the minister of finance.

## 16.2. Risk management system in higher education institutions

Risk management covers operations targeted at a planned and purposeful analysis, risk control as well the control of undertakings. Risk management is planned and purposeful in that activities it involves are long-term and systematic. For the risk management process, it is important that it be integrated with the overall system of HEI management.

The stages included in the risk management process are:

- risk identification and quantification;
- risk response;
- control of the undertaken activities.

The first stage of risk management is of a prognostic and informative nature. Risk analysis begins with its identification, the aim of which is to determine the kind and scope of the risks facing the HEI in the given period. Individual transactions and the tasks implemented are examined and classified in terms of their risk exposure. A precise division of individual transactions into risk groups allows the choice of an effective way of measuring the risk.

Quantification, which is the next stage of the analysis, is about risk measurement through the use of various methods. The method chosen, which can vary from descriptive to a complex econometric model, results from the risk type and the approach of the risk managing staff in the organisation. Most frequently, risk measurement methods are the point method or the discriminant and elasticity analyses. The use of internal models in risk management is also on the increase.

An analysis of specific trends enables us to identify different scenarios of HEI operations, on the basis of which an assessment of future incomes and expenses can be made.

In discussing the analysis of the risk involved in educational activities, it is reasonable to differentiate between individual versus overall risk. The overall risk, in its practical aspect, is calculated on the basis of the probability of occurrence of individual perils carrying a risk of a specific magnitude, and on the interrelations between them. With a defined risk probability and size, a higher positive correlation between the perils results in a higher level of the overall risk.

Overall risk assessment is of key importance in HEI risk management. It is important not only to calculate its absolute magnitude, but also its relative size, which depends on the capital, the reserves and the financial result.

The second stage known as the risk response concerns the efforts to mitigate the risk to a predefined acceptable level. For the risk management process, it is essential to develop an appropriate database that will make the proper risk assessment possible. Risk prevention frequently means the loss of goal attainment opportunities, and is a source of additional spending, e.g., on internal control and insurance. This binds the HEI management team to find an appropriate way of goal attainment, which will take account of the limitations entailed in the need to keep the liquidity and the risk at an appropriate level. With such an approach, it is possible to define the possible opportunities and threats in advance, and then to present the possible changes in specific areas of operation, designed to minimise the risk. The approach taken may be active or passive. In the latter case, the extent of the risk generated by the HEI is assessed and its acceptable level for future periods is defined. The active approach. on the other hand, is about an extra profit derived by the HEI, resulting from its risky operations. To prevent higher education institutions from engaging in operations carrying too much risk, each of them has to apply ceilings based on the reference standards contained in the existing regulation. By regularly providing the managing team with key information, we facilitate the objective-oriented process of decision making. It is vital that the information thus provided is accurate, timely and intelligible to the decision makers.

Two approaches are possible in the risk control process designed to avert it. Measures focusing on the causes of the risk and efforts to contain it are referred to as proactive risk-mitigating strategy. Measures targeted at the results of the risk, on the other hand, the purpose of which is to mitigate the adverse effects of the losses incurred on the financial standing of the HEI, are characteristic of a reactive risk mitigation strategy.

The decision on the extent to which a given strategy will be used largely depends of the preferences of the governing council and the management team of the HEI. The choice of a proactive strategy involves extra costs of protective transactions or a system of control; it may also involve some lost opportunities. In the reactive strategy, the protection is secured by the HEI's assets and contingency reserves. If this strategy is chosen, some of the protective measures and the costs involved may be abandoned.

The final stage of the risk management process is control. It is designed to examine the effectiveness of the risk-mitigating measures. In the process of control, the methods applied in risk analysis are evaluated in terms of their validity and accuracy. From the response stage, it is the instruments used that come under scrutiny – in terms of the benefits obtained and the costs incurred through their application. Control tasks also include an evaluation of the measures taken from the point of view of how the HEI is structured and to what extent it is centralised or decentralised. It is also vital that the degree of integration be checked, between the risk management system and the IT and the accounting systems. At the same time, the function of control is also to make sure that the risk management system is duly intelligible to the decision making team.

An integrated risk management system requires not only full integration of risk management systems with the management systems of the higher education institution, but also integration with specific risk management in its individual entities.

The risk management process is chiefly determined by the strategy adopted by the HEI, especially the acceptable risk level and the value of expected results. Limits within the organisation equal to or in excess of those recommended by the law allow the determination of the accepted risk level.

The principles of risk management process mainly concern its measurement, monitoring and control. Equally important, however, are the rules concerning the responsibility of individual entities within the HEI and communication between them. An important element of risk management is the security of information in the higher education sector. The principles of control should apply to all the entities of an HEI. The proper determination of the rules will secure the entirety and continuity of the whole risk management process.

Information on risk allows appropriate decisions to be taken on the range of educational services provided. The costs connected with the risk incurred affect the calculations of service profitability and its adjustments on account of the scale of the risk.

The infrastructure used in the process of risk management is primarily connected with the duly competent staff and the tasks they perform. It includes databases, computer hardware and software, jointly referred to as the technology. The technology-supported activities of the staff lead to the development of the data necessary for the assessment of the risk in particular areas of the HEI's operations. With data that are complete and accurate, proper risk management is possible, while incomplete or outdated information may lead to wrong decision, thus amplifying the already existing risk [Marcinkowska, 2003, p. 210].

The mounting risk in the market of educational services forces HEIs to have effective risk management systems in place. What matters is not only the ongoing enhancement of risk analysis and risk response methods, but the HEI's adjustment to the frequently changing regulation aimed at risk mitigation. Regulation concerning the operations of public sector entities helps to adjust the amount of risk incurred by HEIs and, indirectly, highlight important aspects of its mitigation.

## 16.3. Security of IT information risk management in higher education institutions.

One of the most important areas of risk management in state-run HEIs is the proper management of information. The management of the security of IT information in higher education institutions comprises:

1) ensuring that internal regulation is updated in line with the changing environment;
2) ensuring that the lists of hardware and software used to process information are up to date;
3) periodical analyses of the risk related to loss of integrity, accessibility and confidentiality of information and measures taken to minimise the security of information risk;
4) ensuring that individuals involved in the processing of information are duly qualified and experienced to safeguard the security of information;
5) providing the necessary training for individuals involved in the processing of information, such training to cover the areas of:
   - security of information hazards;
   - consequences of a breach of information security rules (including legal liability);
   - measures ensuring the security of information (including devices and software minimising the risk of human error);
6) protection of the information processed against theft, unauthorised access, damage or distortion through;
   - the monitoring of access to information;

  - measures to detect unauthorised intervention in the processing of information;
  - measures to bar unauthorised access to operational systems, network services and applications;
7) introduction of rules ensuring secure mobile or teleprocessing operations;
8) such protection of information that makes its disclosure, alteration, deletion or destruction by unauthorised individuals impossible;
9) ensuring an adequate level of security of ICT systems, in particular through
  - software updating;
  - minimising the risk of loss of information caused by breakdown;
  - error protection;
  - the use of encoding that corresponds to the hazards and the regulations in force;
  - file security;
  - mitigation of the risk related to the use of ICT systems;
  - compliance of IT systems with security standards and policies;
10) immediate reporting of information security incidents and quick response to them.

In order to achieve a specific level of security of the information processed in the IT system of the higher education institution, the staff in charge of risk management analyse on a regular basis what protective measures have been implemented. Their analysis covers identification of the measures implemented, albeit informal, and their effectiveness in a given area of information security. The measures are analysed according to the following criteria:
- protective measures already implemented;
- protective measures partly implemented;
- protective measures not implemented.

HEIs in Poland do not have a single document that would specify the scope of the information security management system, with special attention paid to the information security risk (they do not run an Information Security Book). Each HEI should define the scope by delimiting the boundaries of the possible application of an information security management system. In defining the scope, an HEI should consider both internal and external factors, vital security requirements as well as points of contact and interdependence of the measures it takes and the measures taken by other HEIs. Each HEI should develop, implement, maintain and constantly upgrade its information security management system, as provided for by ISO – 270001.

Modern organisations like higher education institutions may not function safely without efficiently acquiring and processing new information. IT systems, which are the nervous system of an HEI, allow the managing team to make good decisions. State-run higher education institutions need unrestrained circulation of information and easy access to relevant knowledge by the staff.

As part of efficient risk management in higher education institutions, we identify the information security risk. Its identification and assessment are among the most difficult elements of the practice of management. The most frequently used methods of risk identification are brainstorming, interviews, identification of potential hazard sources and the Delphi method, using the opinions of experts and auditors – from both within and outside the organisation. A checklist made for other risks can also be used, but the differences between the particular risks have to be kept in mind, so that no serious hazards are overlooked. A survey of historic documents is also a good practice.

The outcome of information security risk should be entered into the risk register of the HEI, which includes a list of risks, a list of responses and the sources of most likely problems. Such a register should be updated on a regular basis. An efficient risk management system includes three important stages:

- risk measurement and analysis;
- risk monitoring;
- preventive measures (risk response).

The latter play a vital role in risk management. Thanks to preventive measures, some risks can be mitigated or eliminated altogether. If this is impossible, there is time to learn to live with them and provide for the possible consequences.

## Conclusion

In a competitive economy, risk is entailed in every activity, educational activities included. The problem has become more apparent in the wake of the rapid changes of recent years and the clear symptoms of the economic crisis. Consequently, publicly funded organisations can no longer be reactive in their attitude to risk and respond only after problems have occurred. Higher education institutions have been forced to adopt a proactive attitude to ongoing risk management, using an integrated management model, within the context of HEI's organisation and strategy. This requires far-reaching changes, especially in the risk management procedures applied, but also in adapting the solutions offered by relevant sciences.

Risk is one of the most important theoretical concepts in the study of finance, but it is also a category that is present in human life and business activity. Most individuals and businesses see the necessity of risk analysis and risk mitigation as well as the protective measures against risk. This translates into a greater role for risk management, including the handling of information security risk, leading to decisions and measures resulting in a level of risk that can be accepted.

The ways of risk mitigation and diversification are an important issue in the operations of every higher education institution. By building a complete and integrated system involving all aspects of risk control and assessment, we are capable of a better, more accurate hazard forecasting, as a result of which the risk can be diversified.

The importance of risk management and ways to mitigate it has grown throughout the world, mostly because of the growing strategic risk in the global economy.

Risk awareness has made us seek ways to mitigate it and protect ourselves against it.

One may claim that modern risk management methods are finding their ways into the Polish market of educational services. Their effectiveness can be demonstrated by their successful application in the management of strategic, operational and project risks in Polish higher education institutions.

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## Chapter 17
# A security subsystem design for a secret registry using RFID solutions

*Jarosław Napiórkowski, Jerzy Stanik*

## Introduction

Although many methodologies and guidelines for designing security controls for a facility or an IT system are available on both the domestic and international market, they are seldom used in practice for designing safeguards. As a rule, systems are designed by specialists and engineers who do not perform any risk analysis, but only use the so-called good practices. Consequently, designs created without appropriate analysis lead to the implementation of controls that are not effective enough and often lack economic justification (e.g. expensive safeguards are used although the risk level is not high, the controls do not protect against relevant threats, etc.). Designing a system of safeguards is often made difficult by the following circumstances (problems):

– when designing controls one should refer to many basic documents (such as Risk Analysis Report, Security Policy, Security Requirements, etc.),
– very often, there is no "link" between the risk analysis findings and the process of designing controls (relevant analysis findings and design outputs are presented in different documents),
– documents specifying guidelines for analysing and designing safeguards use different terminology; in consequence, risk analysis findings may be misinterpreted in the process of designing,
– the available risk analysis methodologies are too complex to be commonly used by engineers; the computer tools facilitating risk analysis (e.g. CRAMM, COBIT) available on the market are too expensive,
– usually, methodologies for analysing and designing safeguards cover a variety of controls representing different categories; when designing controls, one needs to analyse documents and select relevant guidelines.

It would be easier to use a methodology dedicated to secret registry safeguards (i.e. a methodology that would describe the relevant risk analysis principles and the process of designing adequate security controls based on them). The methodology of designing registry safeguards is emphasized to consist of strictly defined procedures determining the sequence of processes intended to prepare, plan, implement and monitor controls, where controls include risk management measures, including policies, procedures, recommendations, organizational practices or structures that may be of an administrative, technical, management-related or legal nature.

## 17.1. An overview of guidelines and methodologies applicable to designing safeguards

The overview of guidelines and methodologies is limited to the following documents:
1) PN-ISO/IEC-27002:2013 Information technology – Code of practice for information security management,
2) Legislation and regulations concerning the security of information technology systems (personal data protection, classified information protection),
3) RFC 2196 (IETF) Site security handbook,
4) CERT guidelines for designing security controls,
5) NIST security management methodologies,
6) SANS Institute publications.

**ISO/IEC 27002 Information technology – Code of practice for information security management**

The standard specifies general guidelines to be followed when designing and implementing security controls. The guidelines cover the following aspects:
1) information technology system access control,
2) segregation of networks,
3) separation of sensitive systems,
4) separation of equipment in operation from equipment used for development work,
5) user identification and authentication,
6) network connection control,
7) network routing control.

**Security-related legislation and regulations**

The considerations of security controls designing and implementation presented in the present study are confined to two legal acts:

A. The Protection of Classified Information Act:
1. Cryptographic protection shall be provided when transferring information in an electronic form outside security zones.

2. A system or an ICT network shall be equipped with access controls adequate[1] to the classification status of classified information processed in these systems or networks. Any ICT system or network equipment, where classified information subject to official secrecy is processed, may be connected to a commonly accessible system or network equipment, provided that adequate access controls are used. An ICT system or network where classified information subject to state secrecy is processed shall be designed, organized and operated in a manner preventing uncontrolled access by one person to all resources of the system or network, including in particular the access to data, software and hardware.

B. The Personal Data Protection Act (controls required for high security level[2]):

1. Protection against threats originating in the public network through the implementation of controls that prevent unauthorized access, i.e. control of the information circulation between the IT system and the public network, as well as control of actions initiated from the public network and the IT system.
2. Cryptographic controls in respect of data used for authentication, transferred within the public network (i.e. user identifier and password protection when logging via the network).

**RFC 2196 (IETF) Site security handbook**

A. The methodology presented in the Site Security Handbook RFC 2196 provides for the following stages of the IT system safeguards design and implementation:

1. Identifying the IT system resources to be protected.
2. Determining the threats to the IT system resources for which safeguards will be designed.
3. Determining the probability of threats occurrence (the scale of threat).
4. Implementing the measures to protect the IT system resources in a cost-effective manner.
5. Monitoring the process and making improvements each time when a threat occurs (a weakness is found).

B. RFC 2196 does not provide any detailed methodology for performing risk analysis or designing safeguards. It provides a general guidance in this respect. As far as designing network controls is concerned, RFC 2196 describes the following elements:

[1] The adequacy of security algorithms and controls used to protect classified information with the given classification status shall be confirmed by the State security agencies (Internal Security Agency, Military Information Services).

[2] High level applies, if at least one element of equipment in the IT system used for processing personal data is connected to a public network.

1) protection planning,
2) separation of services,
3) deny all / allow all model of controls,
4) elimination of unnecessary services,
5) protection of infrastructure,
6) protection of network,
7) protection of services
8) network safeguards.

**CERT guidelines for designing security controls**

According to guidelines specified in the "Secure Infrastructure Design", network security controls should be strengthened based on risk analysis. When designing network security controls, one should bear two fundamental principles in mind:

1. The Principle of Least Privilege
2. Compartmentalization of Information.

**NIST security management methodologies**

A. The document "Risk Management Guide for Information Technology Systems" presents a risk management methodology. NIST distinguishes two processes in risk management – risk assessment and risk mitigation.

B. The methodology proposed by NIST specifies the following stages of risk assessment:

1. System characterization.
2. Threat identification.
3. Vulnerability identification.
4. Control analysis.
5. Likelihood determination.
6. Impact analysis.
7. Risk determination.
8. Control recommendations.
9. Results documentation.

In its document "Engineering Principles for Information Technology Security" NIST presents security principles expressed in engineering terms and intended for application in the process of designing system controls.

1. A security control system consists of many security layers (such as e.g. network equipment built-in protection mechanisms and dedicated protection equipment).
2. Publicly accessible systems are isolated from strategic resources of the information system (e.g. in demilitarized zones).
3. Computer systems and network infrastructures are separated by means of boundary mechanisms (e.g. routers, firewalls).

4. Audit mechanisms are implemented to detect unauthorized use and to support incident investigations.
5. The system of security controls includes mechanisms allowing for reliable identity authentication and user accountability.
6. No unnecessary mechanisms are implemented in the system.

**SANS Institute publications**

SANS Institute publishes a number of guideline documents on designing and implementing information systems security controls.

A. The document "Network Security – A Guide for Small and Mid-sized Businesses" describes actions a company should take to maintain a high level of the information system security.

B. Guidelines for designing network security controls can be found in the publication "Designing a Secure Local Area Network". When designing network safeguards, one should give attention to the following aspects:

1. Securing the network from Internet launched attacks.
2. Securing Internet-facing web, DNS and mail servers.
3. Containing damage from compromised systems and preventing internally launched attacks.
4. Securing strategic internal resources of the system.
5. Building a framework for administrators to securely manage the network.
6. Providing systems for logging and intrusion detection.

C. The publication "Implementation of a Comprehensive Enterprise Virus Defence Infrastructure in a Global Company" presents guidelines for building an effective system of protection against application-based threats (e.g. viruses, bugs, Trojans, etc.). When designing AV protection, one should bear the following principles in mind:

1. Implement a centrally managed and monitored virus defence system (AV).
2. Implement an in-line virus defence appliance to scan SMTP, HTTP, FTP and POP3 traffic.
3. Develop and implement appropriate use policies and institute end user education.
4. Place virus defence on every computer that is attached to the LAN>WAN.
5. Ensure regular AV update (new versions of scan engine and updating the signature base).

## 17.2. A methodology of designing registry security controls

The methodology of designing registry security controls consists of strictly defined procedures determining the sequence of processes intended to prepare, plan, implement and monitor controls. When designing security controls, one should take the following fundamental principles of security into account [Stawowski, 2006]:

1. Compartmentalization of Information – resources representing different levels of sensitivity (i.e. of value and vulnerability to threats) should be located in different security zones. This principle is expanded by the Information Hiding principle. It basic idea is that in an information system access should be given to only as much data as necessary for the system to perform its tasks.
2. Defence-in-Depth – protection of sensitive resources is based on many layers of security controls. This principle is expanded by the following principles: Layered Protection – layers of safeguards supplement and insure each other; Defence in Multiple Places – protection layers are placed in many different locations within the information technology system.
3. The Principle of Last Privilege – the information system users and administrators should be authorized to access only as many resources as needed for the organization to operate correctly. This principle applies also to data and services accessed by external users. It is expanded by the Need-to-Know principle, which requires the information system users and administrators to be given access to information according to their current position and tasks performed at the moment.
4. The Weakest Link in the Chain – the system's security is as strong as that of its weakest element.

### 17.2.1. Requirements

The methodology should determine how to:

1) prepare specifications of the repository security requirements (including risk analysis and controls to be implemented),
2) plan the repository security controls architecture (including e.g. protection components, security zones),
3) plan the information security management system,
4) establish the rules of controls operation and effectiveness,
5) assign operational responsibilities,
6) prepare a plan of acceptance tests.

The methodology should be:

1) complete and user-friendly at the same time,

2) The methodology can be facilitated by mans of computer-assisted tools. For this purpose, a formal description of the network safeguards analysis and design is needed. This task can be performed using the graph theory tools.

### 17.2.2. An overview of the process of designing registry security controls

The process of designing registry security controls consists of the following stages (Figure 17.1):

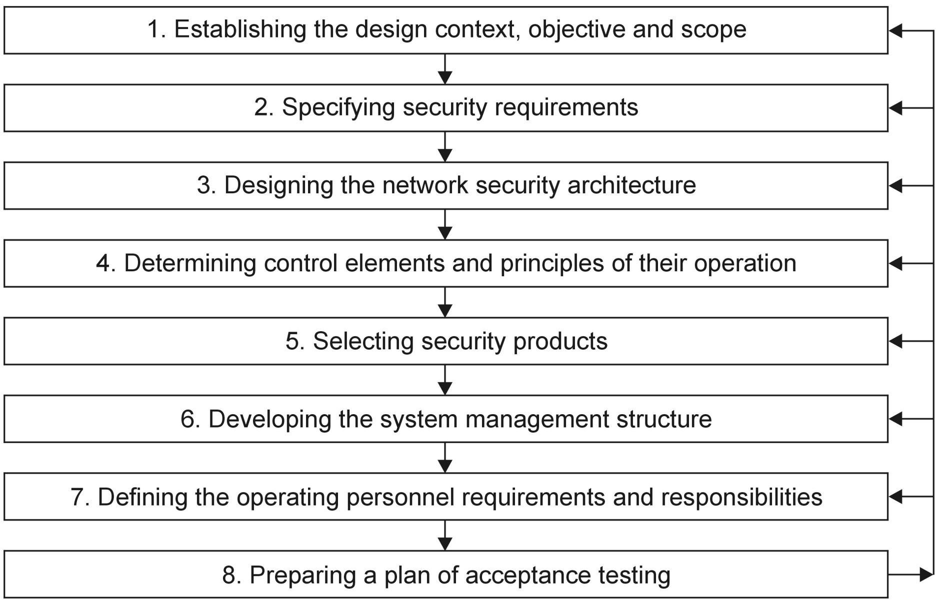


**Figure 17.1.** Stages of the security system designing

Source: Own elaboration.

#### Establishing the design context, objective and scope

This stage involves the following tasks:

– describing the registry operation in the context of the registry security system management,
– defining the basic criteria for the registry security system management,
– defining the objectives, the scope and the boundaries of the system design,
– establishing an appropriate organizational structure dedicated to the security system management.

These tasks yield the following outputs:
- the main objective of the registry and its mission,
- the registry structure (technologies, processes, organization),
- a list of legislative references and regulations applicable to the secret registry,
- a list of requirements addressing the regulations applicable to the registry,
- a list of restrictions,
- basic criteria for the registry security system management,
- a list of sensitive resources, a list of business processes, a list of threats and vulnerabilities, where applicable, with respect to resources.

The operation of a secret registry where RFID solutions are used is based on a number of applicant service processes and internal procedures. Below, registry equipment and operation elements are described. The following has been assumed to provide a correct and consistent description of the registry for the purposes of the security system design:

1. With respect to the registry layout:
   1.1. The registry will consist of two rooms: a room with cabinets and with a system of RFID controls (R1) and a document reading room (R2).
   1.2. The registry may have an entrance-exit zone or two separate zones: entrance (C1) and exit (C2).
2. With respect to security:
   2.1. There shall be a walk-through metal detector gate at the entrance and optionally – a biometric access control kit consisting of at least one such element as a fingerprint scanner, an iris recognition scanner, a finger vein recognition scanner.
   2.2. There shall be an RFID reader at the exit.
   2.3. There shall be a walk-through metal detector at the C2 exit.
   2.4. The R1 room shall be fitted with a CCTV system with motion detectors.
   2.5. Each cabinet in the R1 room shall be fitted with a transceiver suitable for work at RFID tag frequencies used for document protection.

List of requirements addressing the regulations applicable to the registry:
- GIODO (Inspector General for Personal Data Protection) personal data protection requirements,
- Art. 8 of [PCIA] (Protection of Classified Information Act) and relevant secondary legislation (including in particular the Ordinance of the Council of Ministers of 7th December 2011 on the organization and functioning of secret registries and the methods and procedures of processing classified information).

List of restrictions:
1) process-related restrictions:
   - Applicant service – Registry operation in the context of applicant service,

   - Servicing classified materials from/for the carrier – carrier service process,
   - Destroying classified materials – classified material destruction process;
2) infrastructure-related technical restrictions, in relation to:
   - hardware and software installed,
   - the need to protect classified documents kept in the registry, in the context of radio technology being used for the classified material protection.

Basic criteria for the registry security system management include:
- legal, regulatory and contractual requirements,
- risk assessment criteria,
- consequence-related criteria,
- risk acceptance criteria.

The process of defining the security system design objective, scope and boundaries involves the following tasks:
- identifying and valuating the registry assets and estimating the impacts (identifying the resources to be protected),
- identifying the information storage devices and the registry assets vulnerability,
- determining the threats the system being design is expected to eliminate,
- identifying the existing controls and determining the scope of controls to be designed.

These tasks yield the following outputs:
- a list of information resources being processed in the registry and a list of business processes relating to these resources and interfaces between them,
- a list of threats, with their types and sources identified,
- a list of vulnerabilities in resources and controls,
- a list of vulnerabilities that cannot be exploited by any of the identified threats – for the review purposes,
- a list of incident scenarios and their consequences that might affect the registry resources and business processes.

**Specifying security requirements**

According to ISO/IEC-27002:2013, each institution should specify its security requirements at the initial stage of security control planning. These requirements are typically specified in a document titled “Security Policy”. They come from three main sources (Figure 17.2, Figure 17.3):

1. The institution’s risk assessment is the first source. Through risk assessment, threats to assets can be identified, vulnerability to threats and probability of occurrence evaluated and potential consequences estimated.

2. The set of legal, statutory, regulatory and contractual requirements the institution, its trade partners and suppliers are expected to meet is the second source.
3. The set of policies, objectives and requirements in respect of information processing, developed by the institution in order to support its operations is the third source.

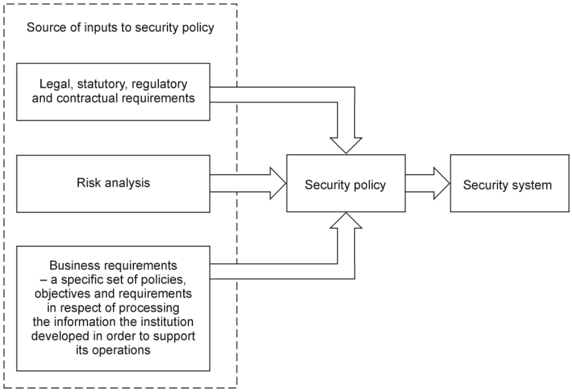


**Figure 17.2.** Sources of information for developing a security policy

Source: Own elaboration.

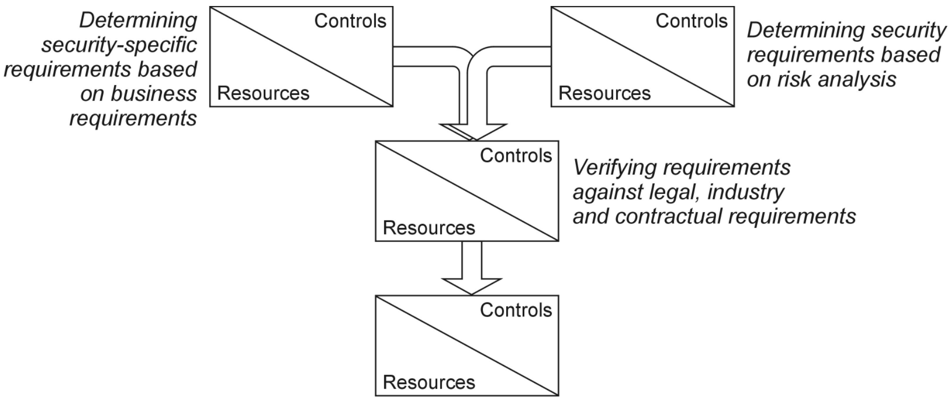


**Figure 17.3.** The process of verifying the conformity of requirements and controls selected for the specified set of resources

Source: Own elaboration.

A. Determining security-specific requirements based on business requirements

The set of registry resources security-specific requirements can be defined by means of the matrix:

$$A^z = [a^z_{i,j}]_{I \times J}$$

where:

- $z \in Z$ – a set of registry resources numbers;
- $z = |1, 2, \ldots, Z|, I = |N|, J = |K|;$
- N – a set (scale) of the information resource value. The information system's resources value (set N) can be presented on a numeric scale from 0 to 4 (0 – negligible 1 – auxiliary, 2 – significant, 3 – very important, 4 – strategic);
- K – a setoff security controls,

$$a_{i,j} = \begin{cases} 1 - \text{when security control is required for a resource} \\ 0 - \text{otherwise} \end{cases}$$

B. Risk analysis

The resource value can be estimated by means of the matrix:

$$B^z = [b^z_{i,j}]_{I \times J}$$

where:

- $z = |1, 2, \ldots, Z|, I = |Z|, J = |N|;$
- Z – a set of registry resources numbers;
- N – a set (scale) of the information resource value,
- $b_{i,j} = \begin{cases} 1 - \text{when the resource has a certain value} \\ 0 - \text{otherwise} \end{cases}$

C. Determining threats to the information system resources and estimating their scale

Threats to registry resources can be estimated by means of the matrix:

$$C^z = [c^z_{i,j}]_{I \times J}$$

where:

- $z = |1, 2, \ldots, Z|, I = |Z|, J = |P|;$
- Z – a set of registry resources numbers;
- V – a set of threats to the information resource,
- $c_{i,j} = \begin{cases} 1 - \text{when the size of threat to resource is significant} \\ 0 - \text{otherwise} \end{cases}$

D. Assessing the information system resources vulnerability to threats and estimating risk value

The registry information resource vulnerability to threats can be defined by means of the matrix:

$$D^z = [d^z_{i,j}]_{I \times J}$$

where:

- $z = |1, 2, \ldots, Z|, I = |Z|, J = |P|;$
- Z – a set of registry resources numbers;
- P – a set (scale) of the information resource vulnerability,
- $d_{i,j} = \begin{cases} 1 - \text{when the resource vulnerability is significant} \\ 0 - \text{otherwise} \end{cases}$

E. Determining security controls to be implemented for the information system resources

Requirements in respect of security controls to be implemented for the information system resources are defined by means of the matrix:

$$Q^z = [q^z_{i,j}]_{I \times J}$$

where:

- $z = |1, 2, \ldots, Z|, I = |Z|, J = |K|;$
- Z – a set of registry resources numbers;
- K – a set of the information resource security controls,
- $q_{i,j} = \begin{cases} 1 - \text{when security control is required for the resource} \\ 0 - \text{otherwise} \end{cases}$

Matrix $Q^z$ of security controls required for the registry resources is determined as follows:

$$Q^z = (B^z \circ A^z) \wedge (D^z \circ C^z)$$

where:

- $B^z$ – binary matrix presenting values of the registry resources,
- $A^z$ – binary matrix presenting registry security specific requirements,
- $D^z$ – binary matrix presenting information resources subject to significant threats and vulnerable to threats,
- $C^z$ – binary matrix presenting threats to the resource and security controls being designed.

The security requirements determined by means of this procedure should be additionally verified in terms of conformity to legal, industry and contract requirements (e.g. agreements with the registry clients and partners).

## Designing the network security architecture

Principles of designing security architecture

The fundamental principle of designing the security architecture requires resources representing different levels of trust to be situated in different security zones. This principle implies the following specific guidelines for designing registry security controls:

1. Registry strategic resources are located in dedicated security zones.
2. Registry users' workstations are situated in other security zones than servers.
3. Security and protection management systems are located within dedicated security zones.

The model of registry security controls is presented as network S (using graph theory),

$$S = \langle G, \{\lambda\}, \{\beta\} \rangle$$

where:

- $G = \langle Z, U \rangle$ – a graph describing the structure of registry information storage devices,
- $Z$ – a set of graph $G$ nodes, representing information resources,
- $U$ – a set of graph $G$ edges, representing direct links between information storage devices, e.g. information system elements (i.e. data transmission cabling and equipment),
- $\{ \lambda \}$ – a set of functions defined by the set of graph $G$ nodes (e.g. technical and organizational controls required),
- $\{ \beta \}$ – a set of functions defined by the set of graph $G$ edges (e.g. security attributes).

The set of functions $\{ \lambda \}$ defines technical and organizational controls to be implemented in respect of the registry information resources, e.g.

$\{ \lambda \} = \{ \lambda$pen, $\lambda$pex, $\lambda$pdc, $\lambda$pcdt, $\lambda$pcrt, $\lambda$fah, $\lambda$vah, $\lambda$ips, $\lambda$av $\}$,

where:

- $\lambda$pen – secret registry entry procedure,
- $\lambda$pex – secret registry exit procedure,
- $\lambda$pdc – classified material depositing procedure,
- $\lambda$pcdt – classified material dispatch by transport operator procedure,
- $\lambda$pcrt – classified material receipt by transport operator procedure,
- $\lambda$fah – firewall with "strong" authentication,
- $\lambda$vah – data transmission protection (VPN) with "strong" authentication,
- $\lambda$ips – intruder detection and blocking (IDS/IPS),
- $\lambda$av – content verification (AV, UF, AS, etc.).

Functions { $\lambda$ } take values from set {0, 1}, where 1 means that the security control is required for the resource and 0 that it is not required. Values of function { $\lambda$ } can be determined based on binary matrix Qz.

The set of functions { $\beta$ } defines security attributes to be maintained in respect of the registry information resources, e.g."

{ $\beta$ } ={ $\beta$co, $\beta$int, $\beta$av, $\beta$uac, $\beta$aut, $\beta$rel, $\beta$rn, $\beta$sn, $\beta$aac, },

where:

- $\beta$co – confidentiality – i.e. information protection against unauthorized access,
- $\beta$in – integrity – i.e. protection against unauthorized modification,
- $\beta$av – availability – i.e. guarantee of authorized access to information,
- $\beta$uac – accountability – i.e. possibility to verify users' responsibility for using the integration platform,
- $\beta$aut – authenticity – i.e. possibility to verify the identity of the integration platform users and the integration platform information,
- $\beta$rel – reliability – i.e. guarantee of consistent and intended operation of the integration platform.
- $\beta$rn – non-repudiation of receipt – the integration platform's ability to prove that the information recipient really received it at a given place and time,
- $\beta$sn –non-repudiation of sending – the integration platform's ability to prove that the information sender really sent it or entered it in the system at a given place and time.
- $\beta$aac – accountability of activities – a guarantee that all activities relevant to information processing have been recorded within the integration platform and that the user who performed each of them can be identified.

**Determining control elements and principles of their operation**

A design of the security control system should contain a complete description of the technical infrastructure (including IT tools, location requirements, etc.) together with a detailed specification of software and hardware and guidelines[3] for configuration of controls.

Stages of designing:

1. Designing access controls protection
2. Designing data transmission controls
3. Designing intruder protection
4. Designing content verification controls.

[3] The design is not a detailed instruction how specific security products should be installed and configured. It should contain however specific and clear guidelines (including security policy principles) enabling a product specialist to implement the product correctly.

When designing access controls (a firewall), one should take into account the basic functionalities of the class of security controls:

1. Blocking any attempts of unauthorized access, as required by the security policy (internal network access control and restrictions).
2. Inspecting internal traffic at many levels (firewall for example exercises control based on individual users' IP addresses, directions and status of connections, protocols and applications).
3. Creating security zones and modelling traffic between them.
4. Hiding network's internal organization and structure.
5. Monitoring security zones in order to generate alerts.
6. Prompt emergency reporting to administrators (e.g. through an alert sent to the interface, an e-mail, a text message).
7. Collecting incident logs.
8. Providing for statistics and reports generating tools.

In the process of designing IPS/IDS controls, the following steps are taken:

1. Identifying the IT system resources to be protected.
2. Determining threats to resources and their sources.
3. Determining response to attacks.
4. Determining IPS/IDC controls location.
5. Developing incident processing procedures.

The information system's resources to be protected can be easily identified using network security model $< G , \{ \lambda \} , \{ \beta \}>$ and function $\lambda$ips. The basic task of IPS/IDS systems is to protect the information system against external attacks (e.g. intrusions, DoS). When designing IPS/IDS protection, one should also address attacks in the form of encrypted sessions (using e.g. SSL). An effective protection measure is encrypted session termination and inspection of decrypted packages.

**Selecting security products**

System protection technology should be selected based on comparative analysis of products that:

- allow for implementation of controls and configurations specified for the project,
- have high market references provided by independent institutions (e.g. International Data Corporation, Gartner),
- have been granted trustworthy security certification (e.g. Common Criteria),
- are compatible with other systems operated in the registry,
- offer satisfactory local technical support and training infrastructure.

### Developing the system management structure

Under normal operating conditions, the system of security controls should be operated and supervised from a central management station located in the protected zone of the network. Control channels need to be protected properly, the controls to include among others:

- access control protection,
- cryptographic protection,
- management system protection against unauthorized interference.

For information systems with enhanced security requirements, additional measures should be taken to ensure management effectiveness and reliability (including system management station redundancy, spare control channels. To provide a reliable incident analysis, the correct system time and date need to be maintained in all security components.

### Defining the operating personnel requirements and responsibilities

To maintain a high security level and correct operation of the system of safeguards, it is required to provide an adequate organizational infrastructure and a competent management team. The registry structure should provide for roles (or additional scopes of responsibility assigned) directly responsible for the operation and supervision of security controls, e.g.[4]:

- a security inspector (officer),
- a system security engineer,
- administrators.

Detailed scopes of responsibilities assigned to the personnel managing and supervising the system of security controls should be specified in security policy documents and instructions.

### Preparing a plan of acceptance testing

As the last stage of designing the registry security controls, a plan of acceptance testing should be prepared. A positive result of acceptance tests is a basis for system commissioning. The acceptance testing plan included in the system design should contain a detailed description of each test (including tools and inputs), with a definition of the expected (positive) result. Acceptance tests consist of two parts:

[4] The security system control and management roles depend on the information technology system type and security requirements (including legal requirements in respect of information protection). For example, the classified information protection act requires that a representative for information security ("security representative") and ICT security representative should be appointed [Journal of Laws 08.02.99], while the personal data protection act requires that an information security administrator should be appointed [Journal of Laws 03.06.98].

functionality tests and tests of integrity and effectiveness of controls. The purpose of functionality testing is to check if all of the network resources and services are accessible at the required level of correctness and quality. Tests of integrity and effectiveness are conducted to provide a reliable assessment of the repository security within the part defined in the design inputs, in terms of integrity and resistance to any undesired interference. Verification of the security system integrity and effectiveness often takes the form of a penetration test with elements of controlled simulation of intrusion.

## Conclusion

In order for the high level of the secret repository security against threats to be ensured, a design of technical and organizational controls has to be developed using a proven methodology and implemented by competent specialists using adequate technologies. The safeguards then need to be maintained by qualified IT staff. Even very expensive security products will not be a guarantee in themselves here.

The design of a security control system should contain the following data:

- the security system architecture – security zones and procedures for cross-zone communication control,
- a technical infrastructure description – IT tools, a hardware platform, deployment requirements, hardware and software operation procedures ensuring security and control,
- an organizational infrastructure description – specifying personnel competence and qualifications, operating procedures for daily operations and emergency response,
- a specification of hardware and software – a complete list of software and equipment required, together with the purchasing cost estimation,
- rules and guidelines for installation and configuration of each individual element of hardware and software,
- acceptance testing plans.

The Table 17.1 is an excerpt from a design showing how the repository security system design methodology can be used in practice.

**Table 17.1.** An excerpt from a list of security controls to be implemented for secret registry resources

| Repository resources | Safeguard required | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organizational controls | | Physical, technical and software controls | | | | | | Network controls of the repository IT system | | |
| | Policyof security and responsibility for resources | Safe operations procedure | Monitoring camera and/or safes | Security zones | Back-up copies | Imperva DataBase Seciurity | Imperva Application Seciurity | Cyber -ARK | Access control (firewall) with "strong" authentication | Data transmision protection | Intrusion detection and blocking (IDS/IPS) |
| Cabinet for classified materials fitted with RFID reader | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Registry clerk workstation with an individual RFID reader and a tray for reading classified material tags | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Reading room workstation with a tray for documents labelled with RFID tags, with an individual RFID tag reader and a terminal or a computer | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Shredder for destroying classified material | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Network printer at the registry clerk's workstation Copier at the registry clerk's workstation | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Internet server | 0 | 0 | 0 | 0 | 0 | 0 | | | 1 | 1 | 1 |
| Application servers | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| Data servers | 1 | 1 | 0 | 1 | 1 | 1 | | 1 | 1 | 1 | 0 |

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## Acknowledgements

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Chapter 18

# Selected aspects of risk management in respect of security of the document lifecycle management system with multiple levels of sensitivity

*Maciej Kiedrowicz, Jerzy Stanik*

## Introduction

The concepts of risk and security are extremely capacious, since they cover a wide range of aspects and areas and can be applied to various entities. Hence, we may talk about technical security or, even more specifically, about military, functional, information security etc. with reference to the whole humanity, a state, a region etc. We may also talk about security of a certain environment, infrastructure, building or object, e.g. a modern secret registry where state-of-the-art RFID solutions are used.

Furthermore, security can be regarded as a guarantee of correct operation of some entities in the context of potential threats. The greater and more likely the threats are, the more difficult it is to guarantee the correct and undisturbed operation. Hence, the more expenditures have to be incurred in order to achieve the required level (degree) of correct operation or security of the entity. The concept of security management will be therefore defined depending on what aspects of security are discussed and referred to.

Nevertheless, the purpose of this study will not be to define or classify any concepts representing the area of risk analysis in information security. The purpose of the paper is to present how system analysis and risk analysis tools can be used for supporting the decision-making process in respect of information security management in a secret registry where up-to-date RFID solutions are used.

"Security" understood as a guarantee of correct (uninterrupted) operation of an RFID Registry is an aggregate of many constituent security areas. Certainly, its global (overall) level depends on the level of individual, constituent (discipline-specific) security areas – it is therefore a function of its constituent levels value.

The proposals presented below can be referred to various areas of security, as well as to various entities, e.g. security of a region, agglomeration, or any technical facility.

## 18.1. A description of the document lifecycle management system with multiple levels of sensitivity for the purpose of risk and security management

A document life cycle management system with multiple sensitivity levels processes, stores and transmits information required for the correct operation of an organizational unit.

In this study, the term document lifecycle management system with multiple sensitivity levels will stand for a modern secret registry where state-of-the-art RFID technology solutions are used, together with the mode of registry operation and management compatible with this technology and enabling work with documents representing various sensitivity levels. The following elements can be found within the secret registry:

1) functional – subsystems:
   - a subsystem for remote identification of unclassified and classified data storage devices labelled for real-time radio-reading at the point of storage and work;
   - a subsystem for automatic inventorying of unclassified and classified documents arranged in piles and filed, including automatic detection of relocation;
   - a subsystem for electronic protection of data storage devices and documents against unauthorized relocation;
   - a subsystem for identification of data storage devices and documents not only at the point of storage, but also at workstations;
   - a subsystem for printing unclassified and classified documents with a copy limit;
   - a subsystem for identifying the location of an individual unclassified and classified document with a pre-set accuracy of a file or volume location;
2) technical infrastructure – renewable and non-renewable elements:
   - various types of RFID antennas;
   - documents labelled with RFID stickers;
   - filing cabinets with shelves, equipped with RFID antennas;
   - filing cabinets with drawers, equipped with RFID antennas;
   - a printer-copier;
   - a tunnel for document file registration;
   - a data base server;
   - an application server;
   - an airlock at the entrance to the registry.
3) control – elements for controlling its on-going utilities and maintaining the current security level:

– a subsystem for controlling the registry information resources flow, with a module for controlling individual levels of authority to access unclassified and classified documents;
– a registry security management subsystem;
– a risk management subsystem;
– a subsystem for automatic control of suitability.

In terms of systemic analysis [Sienkiewicz, 2007, p. 47], the registry security can be considered as the object's property characterizing its immunity to development of a hazardous situation, where the focus is on the object's security fallibility, i.e. its vulnerability to hazardous situations and its operation within a specified time. On the other hand, the registry security should be understood as its capability of protecting its internal values against external threats. Here, a direct correlation with such systemic qualities as: reliability, stability, balance, lifetime is observed. Therefore, the registry security management is an integral part of systemic management and involves rationalization of the combination of measures intended to ensure secure operation of the registry in an insecure environment.

Meanwhile, a security management system is developed to reduce human concerns and fear of the future, assuming however that ensuring a hundred percent security is impossible. Therefore, the purpose is to reduce, not to eliminate, the hazards which are immanent in human life.

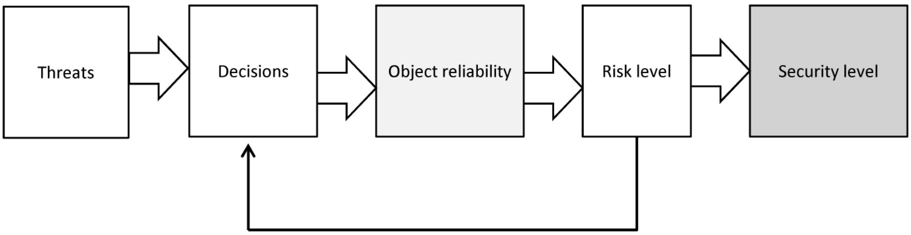


**Figure 18.1.** The chain of elements in the system for managing reliability, risk and security
Source: Own elaboration.

Security and reliability is an engineering discipline that seeks to prevent threats through adequately designed controls with strictly defined functionalities. A functionality has to be designed in a manner ensuring its precise performance under pre-defined conditions of a real threat, at a specified time.

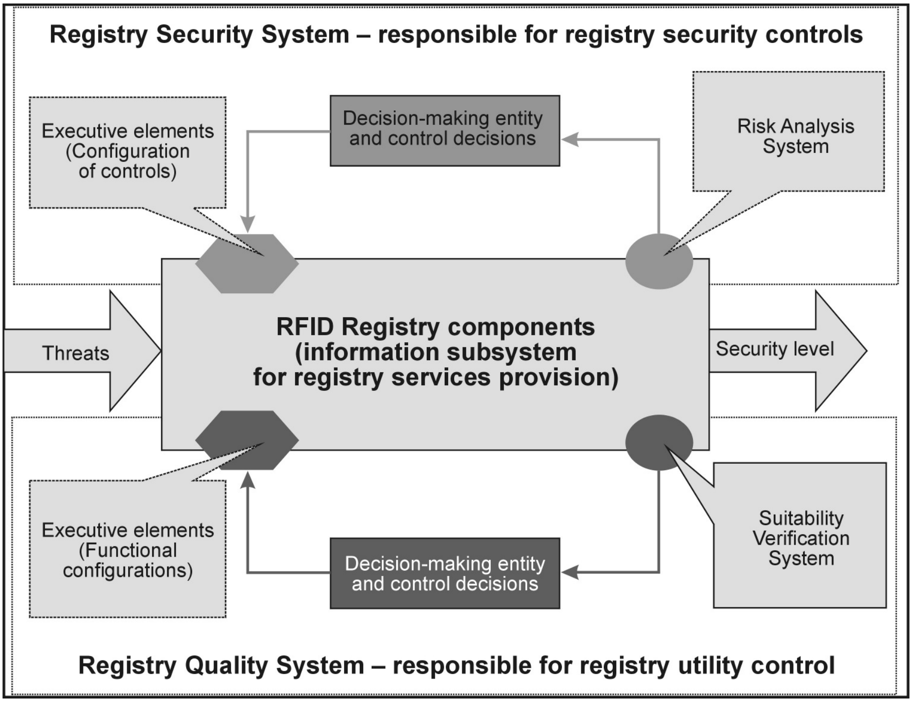


**Figure 18.2.** RFID Registry utility and security level control
Source: Own elaboration.

Security and reliability of the registry are achieved through specialized security and reliability configurations deployed in the registry component elements, to perform security functions in response to input signals – threats. The reliability and quality of security functions are determined by the required level of functional security and reduction of threat caused by a failure. Figure 18.2 presents a graphic illustration of an RFID Registry in terms of controlling its on-going utilities and maintaining the continual security level. Three particularly significant elements can be distinguished in the graph:

1. Component elements of the RFID Registry, defined as the capacity and resources, as well as interfaces between them, ensuring the provision of registry services.
2. Registry Security System, defined as the capacity and resources, as well as interfaces between them, ensuring the required level of the Registry operation security, including in particular the security of its components.
3. Registry Quality System, defined as the capacity and resources, as well as interfaces between them, ensuring the Registry reliability through the possibility of controlling its utilities, including in particular the utility of its components.

## 18.2. The Registry Security System model structure

The RFID Registry operation security is a resultant of its discipline-specific components operation security, these components including for example:
- a classic information system of the registry (rooms, a reading room, individual desks, cabinets and archives) where documents representing various levels of sensitivity are stored,
- document control IT systems supported by Radio-Frequency Identification solutions,
- systems of security zones (e.g. input-output system (zone), I-, II-, III-class security zones, administration zone, etc.).

The level of registry components operation security is determined by their discipline-specific security levels. The operation of each of the registry components may be interrupted by:
- natural hazards: floods, weather, hurricanes etc.;
- technical failures of equipment and systems: power supply, IT etc.;
- civilization hazards: chemical, radiation, communication, etc.;
- geographic and region-specific hazards, such as e.g.: smuggling, nationality issues, religion issues, etc.;
- destructive human behaviour.

Individual hazard types may be present concurrently and have a destructive effect on registry components. Furthermore, potential synergy between hazards should not be disregarded in the registry security analysis. The registry operation security is ensured through:
- continual prevention of development of each individual type of threat to operation of registry components (objects);
- keeping the facilities and forces responsible for the discipline-specific security of the registry prepared for the possibility of each individual threat type occurrence;
- taking effective remedies in case of threat occurrence;
- restoring the functional capacity of objects affected by threats, following elimination of the latter.

The overall RFID Registry security level depends on discipline-specific security levels. The pre-defined discipline-specific security of the Registry can be achieved in many ways – not only through ensuring a certain effectiveness of direct prevention by means of systemic controls. Its level can be also influenced by:
- preventing development of threats to security that have been identified;
- preparing the entity to respond to threat activation;
- education, adequate deployment and availability of emergency prevention and response resources;

– enhancing the effectiveness of security resources and controls when counteracting the consequences of incidents;
– effective elimination of consequences of incidents.

Hence, we are capable of influencing both the discipline-specific and overall security level. The values that can be controlled in this case include characteristics of factors determining the Registry security level, namely those related to:

– preventing possible threats to its security;
– preparing the Registry for activation of these threats;
– safeguards against these threats;
– elimination of the hazardous event consequences.

Hence, each Registry has to seek to ensure the stability of its security. With this end in view, the Registry security system is developed. Two subsystems can be distinguished in the Registry Security System model (Figure 18.3):

– an executive subsystem, which consists of the capacity and resources performing executive processes;
– a registry security management subsystem, performing information and decision-making process that determine the method used for ensuring the security of each individual registry object through the executive subsystem.

It is assumed that the objective of the Registry Security Management Subsystem (RSMS) is to maintain the required security level at the Registry seen as a functional entity and to ensure the security of sensitive resources. This objective can be achieved through the on-going control of the executive subsystem which is responsible for the use of controls. The Registry Security Management Subsystem (RSMS) consists of two subsystems (Figure 18.3):

1) an information subsystem – responsible for continual processing of information needed to make decisions relative to ensuring the Registry operation security;
2) a decision-making subsystem – making decisions in respect of the executive subsystem to ensure the security of each individual object.

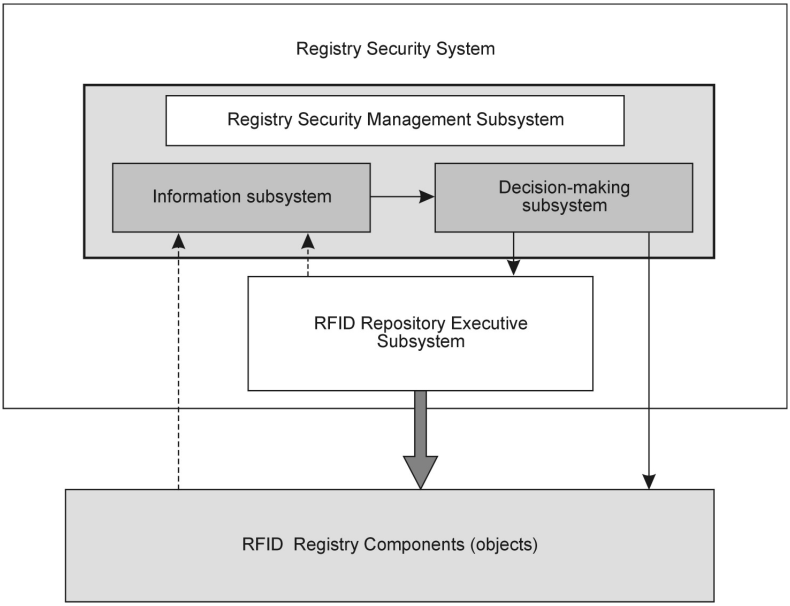


**Figure 18.3.** Functional structure of the Registry Security System

Source: Own elaboration.

The following categories of information are needed to make decisions in respect of ensuring the registry security (Figure 18.4):

1) data describing the RFID registry infrastructure and its environment – relevant to ensuring the security of its operation;
2) operational data of security mechanisms (technical and organizational safeguards) that can be used in a situation if a certain threat to security of the organization's operation occurs;
3) data describing the current status of threats to the registry operation security, including for example:
   - effectiveness of security mechanisms (controls, safeguards) being used,
   - sensitive resources risk level,
   - new threats in the registry environment and its surroundings,
   - weak points in security controls and security gaps identified,
   - suitability and fitness of the registry basic elements
   - recommendations of the risk analysis team manager in respect of the risk treatment strategy;
4) a risk treatment plan and a set of control decisions (directives) to be activated by the decision-making element:
   - a risk treatment plan which specifies a list of organizational and technical controls required to be implemented within the registry components – the current configuration of registry safeguards,

- decisions concerning activities of the Executive Subsystem in respect of security assurance,
- decisions concerning activities of the registry objects in respect of ensuring the security of their operation.

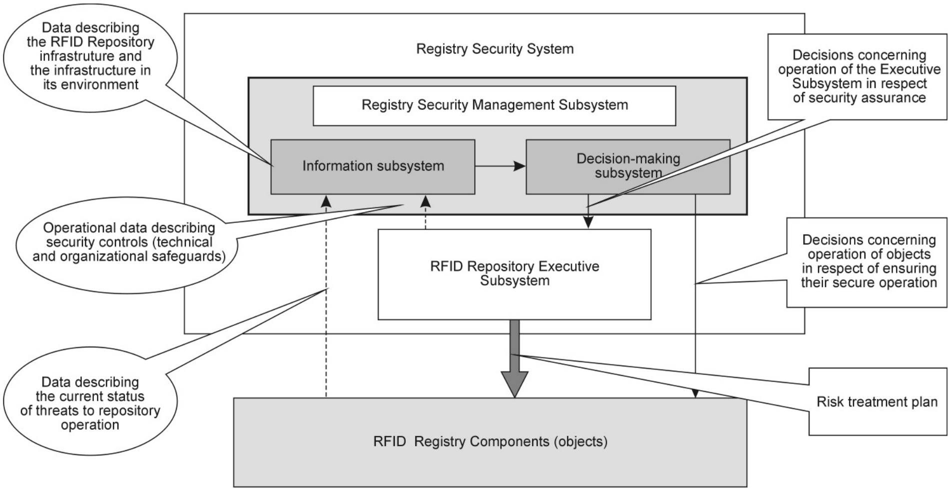


**Figure 18.4.** Information flows in the registry security management
Source: Own elaboration.

Each category of threats to the Registry operation security affects Registry elements – individual types of objects – in its own way, but special attention should be given to information resources representing various sensitivity levels. Accordingly, different prevention, preparedness and response measures apply to each of them. Hence, the Registry Security Management System is a set of Registry Discipline-Specific Security Systems (RDSS).

## 18.3. The Registry Risk Management System model structure

### 18.3.1. A description of basic activities in the process of developing and implementing a registry risk management system

The following definition of a Registry Risk Management System has been accepted for the purpose of this study:

"Registry Risk Management System (RRMS) – a set of principles, controls and tools (including policies and procedures for risk for identification, measuring, monitoring and treatment) referring to risk review processes in a secret registry"

The purpose of the secret registry risk management system is to identify, measure or estimate and monitor risks present in the registry operations, in order to ensure the correctness of the registry services provision. The Management System should allow for a retrospective assessment of effectiveness of the actions taken in respect of:

- business processes of the registry services provision subsystem,
- employees and users of the registry,
- technologies being used.

The RRMS consists of the following three elements:

- Risk Management Policy,
- Organizational Structure dedicated to risk management,
- Risk Management Procedures.

The implementation of both policy and procedures is preceded by registry evaluation in terms of risk. Owing to this, the risk management system is not detached from reality. The existence of a RRMS does not leave space for any risky operations to be taken by the registry personnel or users, as the system describes in detail what is permitted. A well-designed and implemented RRMS:

- supports the entire lifecycle of each risk,
- facilitates the process of information exchange throughout the registry,
- makes it possible to categorize all of the registry risks,
- is fully integrated with other systems existing in the registry.

The registry risk management system is assumed to require periodical adjustments in order to accommodate:

- new trends and changes on the global risk map (which is worth attention in the risk analysis process),
- recommendations and guidelines specified in risk management standards.

### 18.3.2. A description of basic activities in the process of developing and implementing a registry risk management system

The set of basic activities in the process of developing and implementing a fairly comprehensive risk management system may include for example:

1) defining risk management objectives and tasks,
2) identifying risks in the object's internal and external environment,
3) developing a risk management strategy,
4) designing and implementing risk controls,
5) monitoring the effectiveness of risk treatment procedures,
6) improvement.

Figure 18.5 shows the risk management system structure.

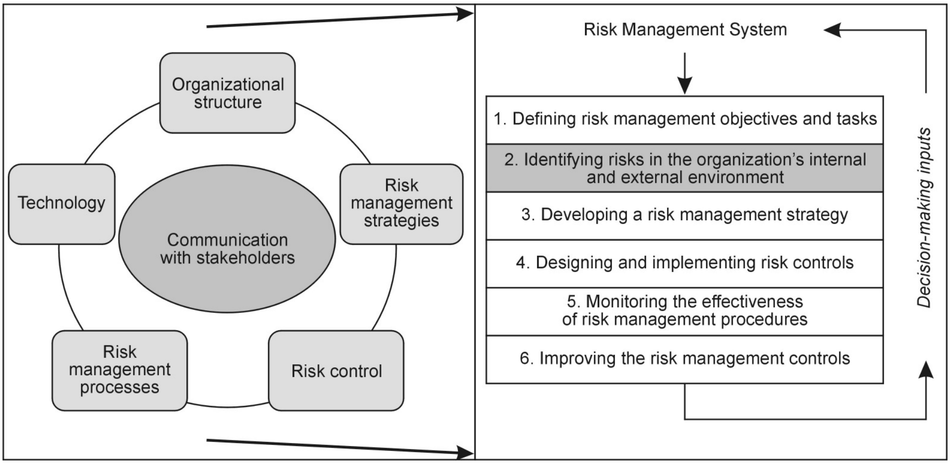


**Figure 18.5.** Basic elements of the risk management system

Source: Own elaboration.

## Defining risk management objectives and tasks

This task includes the following [Figure 18.6]:

– defining the organization's risk management policy,
– establishing a "common understanding",
– defining an efficient organizational structure,
– integrating the risk management policy with the general strategy of the organization.

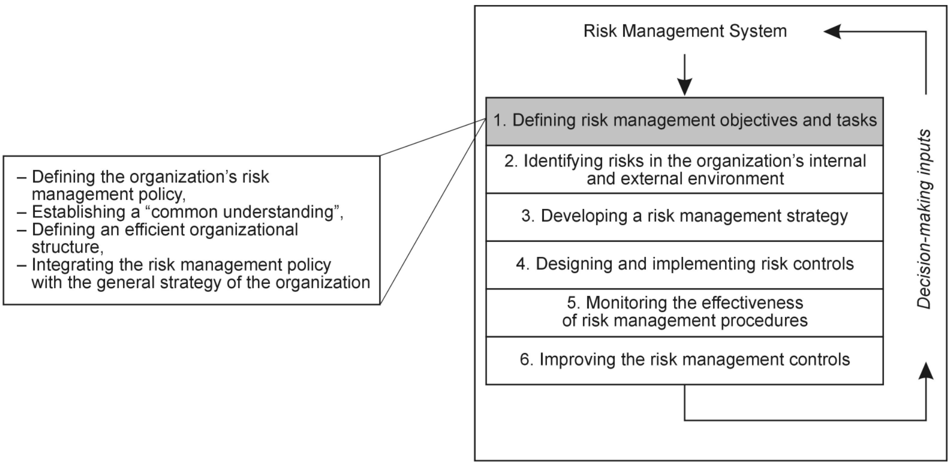


**Figure 18.6.** Elements of the risk management infrastructure

Source: Own elaboration.

To implement the risk management policy in the organization, one should begin with establishing the organization's risk management objectives and goals and aligning them with its general strategy. The risk management policy depends to a great extent on the nature of organization's activity, on its approach to risk and its risk appetite, as well as on determinants originating in its external environment. To support the process of effective risk management system implementation and maintenance, it is necessary to establish a "common understanding" in respect of risks throughout the organization and its environment. Without such common ground for discussing organization's risks, neither any effective communication is possible, nor any effective risk management system can be implemented throughout the organization, since it is impossible to control something that has not been defined clearly or identified and is not understood in the same way by all members of the group. The reason is that employees differ in their perception of risk, depending on the level of the organizational structure they represent (top management, mid-level management, rank-and-file employees), their responsibilities (core or auxiliary processes) or the location they work at (head office, branch offices), although they are all members of one and the same entity. The problem of establishing a "common understanding" of risks across the organization can be solved in practice by using a standard risk model, which defines in detail the most common risk categories.

The next element of the risk management system which needs to be defined at the stage of setting objectives and goals of the risk management processes is the role of organization's employees and management in this system. All levels of the organization – i.e. staff, managers – should have their scopes of responsibility defined in respect of the risk management system, within their relevant areas. In this way, the foundations can be created to enable adequate, active participation of the organization's employees and management in the operational risk management. In addition, the specific scope of risk management responsibility assigned to each individual employee and management member in the organization should be accompanied by an adequate model of communication, reporting and co-ordination of work. The entirety of activities discussed above represents a sort of "infrastructure" of the risk management system, setting directions and facilitating the risk management system implementation. In practice, these elements are often missing or are considerably limited. Frequently, organizations follow risk management policies that have not been formally defined in this way.

**Identifying risks in the organization's internal and external environment**

Figure 18.7 outlines the scope of activities to be taken to identify risks in the organization's internal and external environment. To be controlled effectively, the organization's risks/risk factors need to be identified in the first place, i.e. the most significant threats to organization's operations need to be determined. The process of risk identification and analysis should be documented.

To identify risks, it is often recommended to conduct workshops where employees representing all areas of organization's activity discuss definitions of all individual internal and external risks, analyse their causes and estimate their significance and probability. Such workshops provide an opportunity for confrontation of opinions about organization's internal and external risks expressed by most experienced members of the organization representing various areas of its activity and levels of its management structure.

The aggregated output of the Risk Workshops is a list of all risks of the organization, prioritized in terms of significance, with specific definitions assigned to each of them and their causes identified. The method used to identify risks is not a key determinant of the identification correctness.

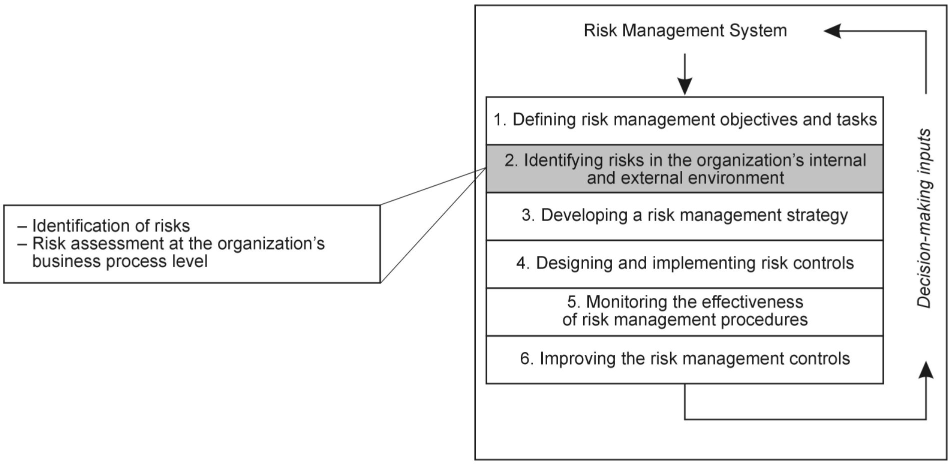


**Figure 18.7.** Identification of business risks
Source: Own elaboration.

It is a matter of greatest importance for the organization to be able to identify its main threats (risks), to prioritize them and to determine the areas of the organization that can be affected. The process of risk identification and analysis should be planned and systematic and should be performed once a year at least. Risk identification should cover the organization as a whole, as well as each significant area, project or program. According to the security control standard, the entity's/organization's manager shall systematically, at least once a year, identify external and internal risks associated with the achievement of organization's objectives, both for the whole organization and for its specific programs, projects or tasks. Risk identification should be repeated whenever the circumstances under which the organization operates change.

**Developing a risk management strategy**

Figure 18.8 outlines the scope of activities to be taken to develop a risk management strategy. Having drawn up a list of risks associated with its operations, the organization is able to develop strategies intended to provide effective risk management. The process of risk management strategy development should begin with appointing individuals responsible for preparing risk-specific strategies.

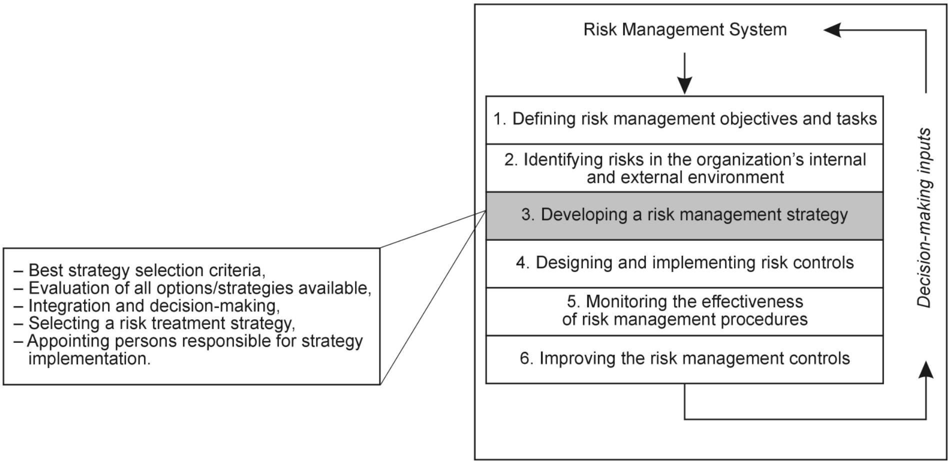


**Figure 18.8.** The process of developing a risk treatment strategy.
Source: Own elaboration.

Risk owners should be appointed based on the interfaces between individual risks and the process for which the person is responsible. The fundamental decision to be made when developing a risk management strategy is to determine whether the organization is choosing to accept the risk or to reject it. The answer to this question depends on whether the risk is embedded in the organization's core processes and its strategic operations, or is an effect of its sideline activities. A decision not to accept a risk results in adopting a risk avoidance strategy. Risk acceptance, depending on the impact of the existing risk level on the organization's operation, may lead to a strategy which involves risk retention, reduction or transfer. When risk owners have been appointed and various risk management strategy options and variants analysed, a decision needs to be made regarding risk-specific strategies. It is a matter of great importance that strategies selected for each individual risk are aligned with the overall strategy of the organization and with strategies adopted with regard to other risks. The strategies should be mutually consistent and coherent throughout the organization and they should translate into concrete actions required to implement them. These actions should be monitored on a current basis.

### Designing and implementing risk controls

Risk management strategies developed in the organization should be translated to the language of specific actions required to implement the strategies. Risk management controls can be defined as a set of the following elements (Figure 18.9):

- strategies and policies – general risk management principles, adequate to the area,
- operational processes and risk management processes – detailed risk management procedures embedded in the on-going operational processes,
- people – operating personnel carrying out operational processes, familiar with the risk management process and preparing detailed risk management procedures,
- executive reports – reports for the organization's management, describing the degree of organization's "openness" to risk, trends in risk indicators, activities taken to implement the risk management strategy,
- methodologies – solutions available to operating personnel, supporting them in operational processes and in the risk management process (analyses, an evaluation system),
- systems – IT solutions supporting the operating personnel's work.

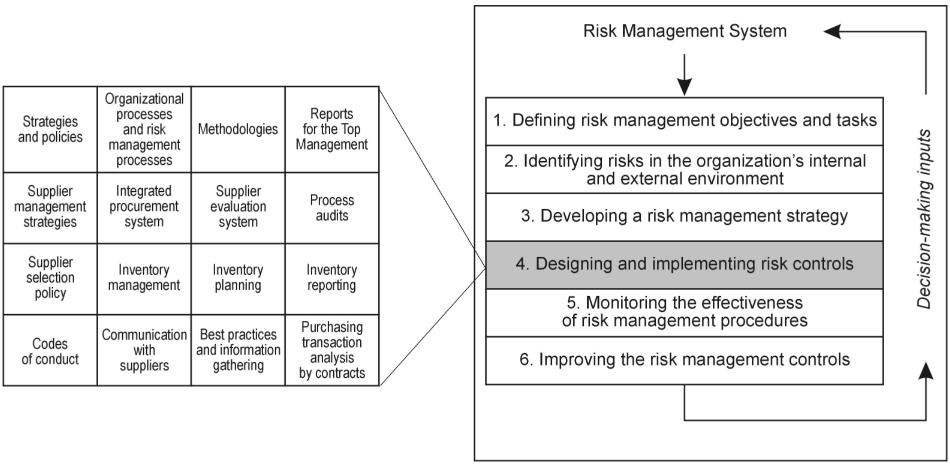


**Figure 18.9.** Examples of risk management procedures

Source: Own elaboration.

The above-listed individual elements are extremely important for the risk management system, but the key matter here are interrelations between them and the necessity of concurrent, parallel development of all elements. If one of the risk management elements is distinctly less advanced in development than the others, the whole system is inefficient and weak. Risk controls are developed and implemented in a continual manner. Each individual element should be subject to continual improvement.

**Monitoring the effectiveness of risk management procedures**

To implement an effective risk management system, appropriate procedures are required for monitoring the risk management strategy implementation in respect of all elements it applies to. The risk management system should be monitored by individual risk owners, as well as by the organization's top management who, being not directly involved in the operational process of risk management, should be kept informed about all issues relevant to risk management. The process of monitoring the effectiveness of risk control procedures includes formalized reporting (covering, among other matters, risk-specific indicators), regular meetings dedicated to reviewing all important issues identified within the existing risk management procedures, as well as periodical audits and inspections of the system (Figure 18.10).

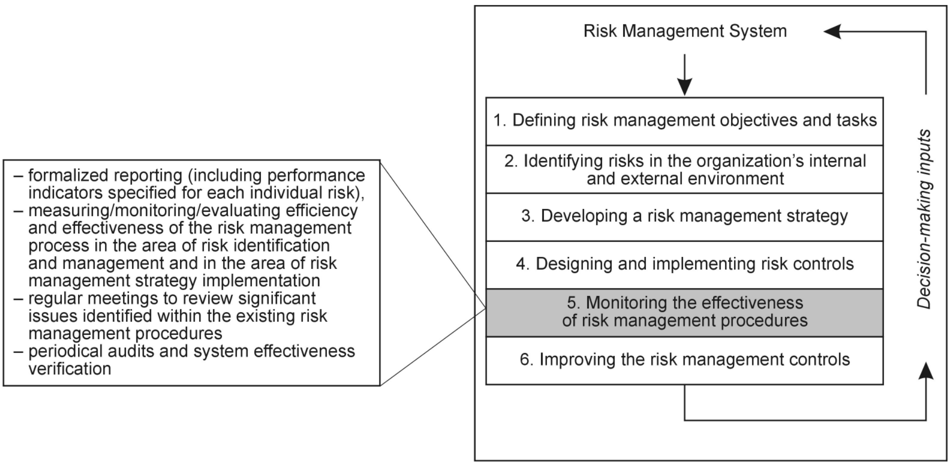


**Figure 18.10.** Monitoring the effectiveness of risk treatment procedures

Source: Own elaboration.

Monitoring covers the following:

– the risk management system objectives and goals (the adequacy of organization's overall strategy and risk management structures is evaluated),

– the business risks that have been identified (the adequacy of the risk profile is evaluated in the light of changes occurring inside the organization and in its environment),
– the risk management procedures,
– the procedures for improvement of the risk management controls (system improvement procedures are evaluated in terms of their adequacy and contribution in enhancing its effectiveness).

Effective monitoring enables the organization's management to evaluate the correctness of the risk management system.

**Improving the risk management controls**

At this stage of the risk management system's lifecycle it is necessary to ensure continual improvement of the process of risk evaluation, treatment and monitoring (Figure 18.11).

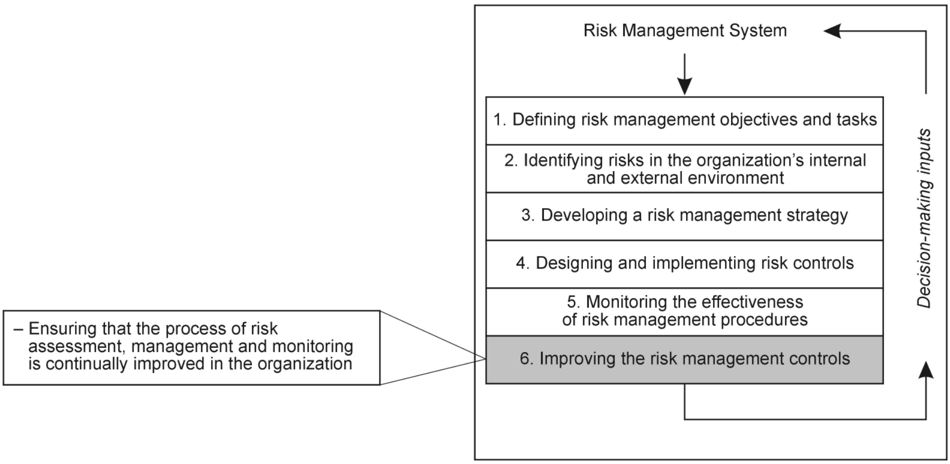


**Figure 18.11.** Improving the risk management controls

Source: Own elaboration.

The element of risk management controls improvement is embedded in the fundamental principles of the organization's overall risk management system. The risk management process evolves from an "initial" phase (unorganized actions), through a "repetitive" phase (with basic risk management controls implemented, tasks, limits resources and control processes identified, competent personnel appointed and training provided, a "defined" phase (with a complete set of risk management controls implemented, policy defined and institutionalized, processes, standards, risk management processes integrated and documented throughout the organization), a "controlled" phase (risk measured and quantified, controlled in an aggregated manner throughout the organization, risk measurement and analysis methods strictly applied, full awareness and communication in respect of the profit/risk correlation) up to an "optimal" phase (best practices being used, on-going feed-back to the process of continual improvement provided, risk management strategy implemented throughout the organization). The most important thing is to replace irregular, unorganized ad hoc actions and relying on employees with management procedures embedded in business processes, interrelated and enabling proactive risk management.

### 18.3.3. Recapitulation

The above example of six phases in the risk management system development is proposed as a model solution, showing the registry such as it should be organized. Selected risk management system elements can be implemented in the registry almost always, but these activities are often carried out in an informal manner, at the lowest – operational level (this happens e.g. when identifying internal risks, developing risk management strategies, etc.).

Management standards dedicated to both security and risk issues, while not legal requirements in themselves, provide the guidance needed to identify and analyse risk, as well as to determine risk mitigation measures.

## Conclusion

Any activity taken by any organization involves risk. Risk and/or security management processes should constitute an inseparable part of every organization's life. However, for the risk or security management process to be effective, one should consider which management methods, techniques or tools will be best for the organization.

The study presents only some of the selected options of using the systemic analysis and risk analysis methods, techniques and tools in modelling security systems and evaluating their quality and security level. The field of security is, as no other discipline, multifaceted and characterized by very complex phenomena, therefore it requires advanced mathematical modelling tools and a risk management process in the information security area. Such methods, techniques and tools are offered by the following standards:

1) international standards dedicated to information security management:
   - ISO/IEC 27001 Information security management systems Requirements,

- ISO/IEC 27002 Information technology – Code of practice for information security management;

2) international risk management standards:
   - ISO/IEC 27005:2013 Information technology. Security techniques. Information security risk management;
   - IEC Guide 73:2009 Risk Management–Vocabulary – Guidelines for use in standards (2009),
   - IEC/ISO 31010 Risk management – Risk assessment techniques (2009),
   - ISO 31000 Risk Management – Guidelines for principles and implementation of risk management (2009);
   - AS/NZS 4360:2004 Risk Management (Australia, New Zealand 2004),
   - COSO II – ERM Enterprise Risk Management – Integrated Framework (USA 2004).

The standards listed above point out that when implementing a risk and/or security management system in an organization it is necessary to use appropriate methods of collecting information and mechanisms of responding to threats. It seems that the key to success is to adopt an integrated approach to risk management (ISO 27001, ISO 27005,COSO II, ISO 31000) and to develop and implement an effective security management system which provides sufficient information for making informed and rational business decisions, thereby enabling the organization's management to evaluate information security risks on a current basis.

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Normy i standardy:
8. PN ISO/IEC 27001 Systemy zarządzania bezpieczeństwem informacji. Wymagania.
9. PN ISO/IEC 27005 Technika informatyczna. Techniki bezpieczeństwa. Zarządzanie ryzykiem w bezpieczeństwie informacji.
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## Acknowledgements

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Chapter 19

# A proposal of a platform for the integration and analysis of threat-related data within the National Security System of the Republic of Poland

*Tomasz Protasowicki, Jerzy Stanik*

## Introduction

One of the roles of the National Security System of the Republic of Poland (NSS of RP) is to ensure the inviolable survival of the state. To meet this challenge it is necessary to provide all-inclusive support to information and decision-making systems associated with the identification and evaluation of opportunities, challenges and threats to national security. This involves the capturing, integration and exploration of data dispersed throughout many different systems (domain specific, expert systems, supporting decision-making processes, etc.) dedicated to support the participants of the National Security System performing their often highly specialized tasks. Currently, Poland does not have any integrated, all-inclusive information technology system that would allow data related to threats to national security to be captured and processed based on a joint data base aggregating information sourced from many different systems in a systematized manner.

The purpose of the research work was to design a generic model of a platform intended for the exchange of threat-related data between the members of the NSS of RP, while also allowing thorough exploration and analysis of these data. Considering this objective, the research procedure consisted of the following steps in particular: the nature of the NSS of RP was defined (with the basic terms defined and the process of national security control determined), the key factors determining the development of a platform for integration and analysis of threat-related data were identified and analysed and a reference architecture of an information technology system was proposed. Furthermore, an assumption was made that information to be processed within the platform would pertain to military and non-military threats to national security and the platform itself would be based on a system of facilities and tools for capturing data and performing various data transformations and analyses, as well as storing additional structures that support their operation.

## 19.1. The National Security System of the Republic of Poland

The term security derives from the Latin expression *sine cura = securitas* (without care) and is commonly associated with a negation, namely – the absence of any threats, while dictionaries usually define security positively, as a state of certainty and confidence, opposite to dangers. In scientific discussions, on the other hand, the term is defined depending on the author's standpoint and closely associated with the theoretic approach to the science of international relations he or she represents [Zając, Zięba, 2010, p. 8].

National security is the ability of a state to ensure conditions for its existence and development, territorial integrity, political independence, internal stability and the quality of its citizens' life. This ability is developed through activities taken to capture opportunities, face challenges, reduce risks and eliminate external and internal threats, thereby ensuring the continuity, identity, functioning and developmental freedom of the state and the society [Zając, Zięba, 2010, p. 9].

The National Security System of the Republic of Poland (NSS RP) is the entirety of forces (entities), means and resources allocated by the state to perform security tasks, arranged (in sub-systems and links), maintained and prepared in a manner adequate to the purpose of performing such tasks. It consists of the management sub-system (system) and a number of executive sub-systems (systems), including operational sub-systems (defence and protection) and support sub-systems (social and economic) [BBN, 2013, p. 250].

The role of NSS RP is to ensure the inviolable survival of the state as a political institution and a continual and free from disturbances existence and development of the society through effective engagement and employment of the available forces, means and resources to reduce security risks, eliminate threats and follow an active policy of using the emerging opportunities [Protasowicki, 2014].

To perform the a/m tasks correctly, it is necessary to create a platform for the integration and analysis of data pertinent to military and non-military threats. The platform needs to accommodate adequate IT methods and tools so as to provide an all-inclusive support to decision-making processes associated with the identification and evaluation of opportunities, challenges and threats to national security.

### 19.1.1. Challenges, chances and threats to national security of the Republic of Poland

Challenges, opportunities and threats are general terms, commonly encountered in the literature of the national security subject. These concepts are key to understanding the essence of the national security management in RP [Nowak, Nowak, 2011; Wojnarowski, 2010].

Challenges constitute a primary concept in the national security analysis. They are represented by events that have already occurred or may occur in the future, but their impact is unclear. A challenge looked at through the prism of the state's system of values, interests, intentions and goals may take the form of an opportunity (if its nature is a positive one) or of a threat (if it is negative in nature). Challenges may stem from external or internal circumstances present in the state's national security system. Moreover, it should be noted that a challenge representing an opportunity for one state may be a threat to another one [Nowak, Nowak, 2011; Wojnarowski, 2010].

An opportunity is a circumstance, the occurrence of which is conducive to development and allows creating new directions of social activities that translate into a possibility of succeeding in the achievement of the state's goals in the national security domain.

A threat is a circumstance, an event (or a sequence of events) caused by a fortuitous event or otherwise. In the national security context, its occurrence affects the functioning of the state and its internal balance or causes adverse changes to its external environment [Nowak, Nowak, 2011; Wojnarowski, 2010; Ficoń, 2007]. The accumulation of threats and the lack of any adequate responses initiated in due time may result in a loss of conditions for undisturbed existence or in a violation or a loss of the state's sovereignty and its status of a partner in international relations [Jakubczak, 2003]. Threats to national security can be classified based on various criteria: subject-related criteria, the source of threat, the environment, the range of threat, the effects of threat, the location of threat, the nature of social relations, etc.

Finally, one should note that a new situation may become a challenge to take up certain actions in response to an opportunity or a threat. Opportunities that have been identified are not subject to security management, but they may be used as a basis for decision makers to work on visions and plans. Identified threats, on the other hand, initiate the process of Poland's national security control.

### 19.1.2. Republic of Poland's national security control process

The process of Poland's national security control is determined by a number of factors. The main determinants include various types of threats and various degrees of vulnerability to these threats in each individual area, domain and institution relevant to national security. Determining the analysis and evaluation methods and techniques to be used in respect of both probability and intensity of undesired incidents, as well as the scale of potential consequences in the event of their occurrence is not unimportant for the effectiveness of this process. The process of security assurance involves the use of methodologies and methods designed to assess threats, vulnerabilities and consequences of threats, for the purpose of risk analysis with respect to threats to national security of Poland. With the progressive development of civilization and changing economic and political environment, the role of risk management in everyday life is growing. Hence, in the operational sense, the control of Poland' national security can be identified with managing risks associated with threats that have been identified. The unification follows from the need to uniformize risk assessment in terms of comparing individual risks for the purpose of decision making, while risk itself is a measure of threat here.

From the point of view of the NSS of RP, control covers all identified threats to the functioning and development of the state, the society and the citizens. The overall and effective control of national security is based on the identification and assessment of all national-scale risks prioritized based on a coherent catalogue of threats. Threats are identified and forecasted through the on-going monitoring of the situation and prediction of changes. According to art. 2 of the Act of 26 April 2007 on Crisis Management, the activities of the state administration institutions involved in the national security control includes preventing emergency situations, preparedness for taking control of these through planned actions, responding to emergency situations, eliminating their consequences and restoring critical resources and infrastructure.

Security control in the context of a single threat is illustrated on Figure 19.1. The subsequent phases of the threat lifecycle require a wide range of resources that in many instances cannot be planned in advance. The figure shows also the dynamics of these resources engagement in each individual phase of the threat lifecycle.

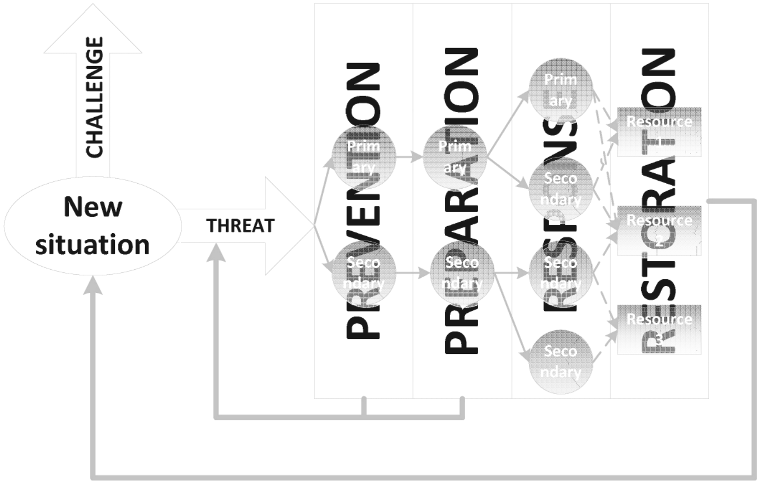


**Figure 19.1.** The lifecycle of a threat

Source: Own elaboration.

## 19.2. Factors determining the development of a platform for threat-related data integration and analysis

Data processed into information significantly add to the improvement of decision-making, especially at the stage of prevention and in the phase of preparing the national security control process (Figure 19.1). A platform for the integration and analysis of threat-related data in the National Security System of the Republic of Poland will allow these data to be organized in one consistent and efficient system, with a strictly defined functionality. Therefore, this solution will make it possible to build a solid foundation for the effective operation of Poland's National Security System.

### 19.2.1. Information and decision-making processes requiring the information technology support

The information and decision-making process is defined as a cycle of organized activities, expressed in the form of an algorithm of identification and preparation of activities presenting a logical sequence of interdependent stages and actions [Bieniok, 1999, p. 57–58]. Figure 19.2 presents a generic model of the information and decision-making process in respect of the national security control in the Republic of Poland.

The National Security System of the Republic of Poland has to meet high requirements in the field of threat identification and prevention, therefore the flow of information and decision-making processes needs to be efficient at all levels of the state (i.e. central, regional and local). Consequently, these processes have to be supported by integrated IT solutions comprising various classes of components (sub-systems) that enable e.g. simulation, forecasting, historical data analysis, data exploration and processing in the geographic context.

The diagrams below (Figure 19.3–19.5) present examples of information processes that require IT support.

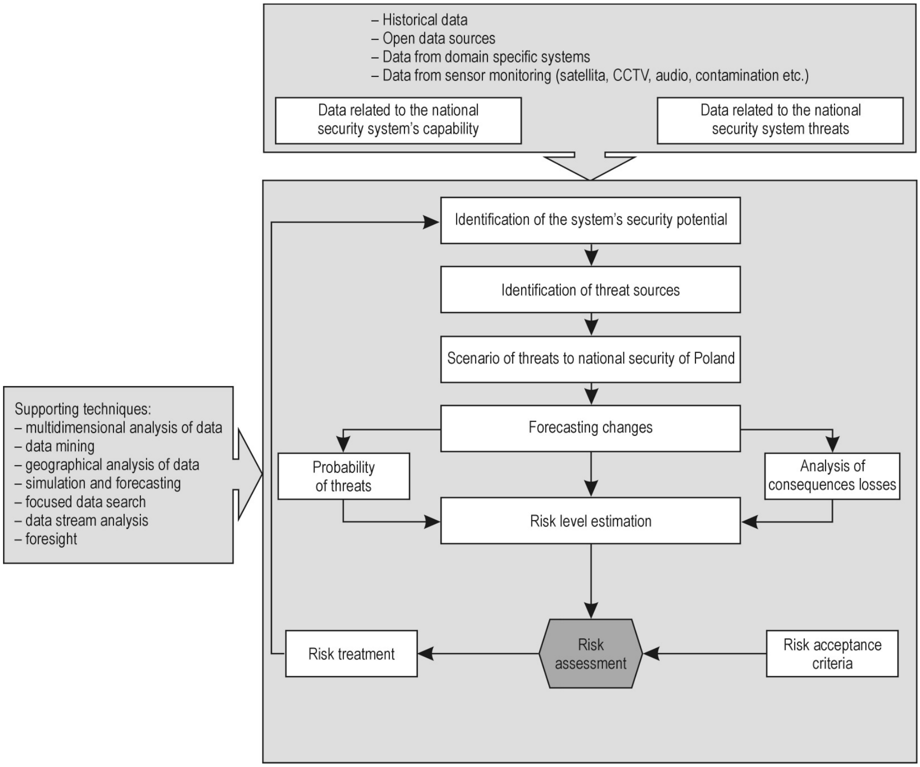


**Figure 19.2.** A model of the information and decision-making process based on risk analysis

Source: Based on P. Sienkiewicz (ed.), Zarządzanie ryzykiem w sytuacjach kryzysowych, AON, Warszawa 2006.

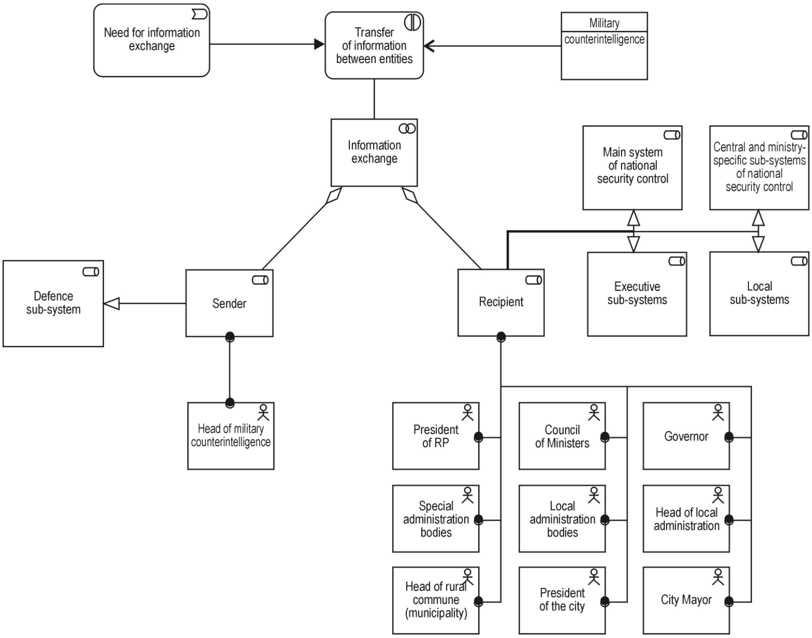


**Figure 19.3.** Military counterintelligence information exchange

Source: Own elaboration.

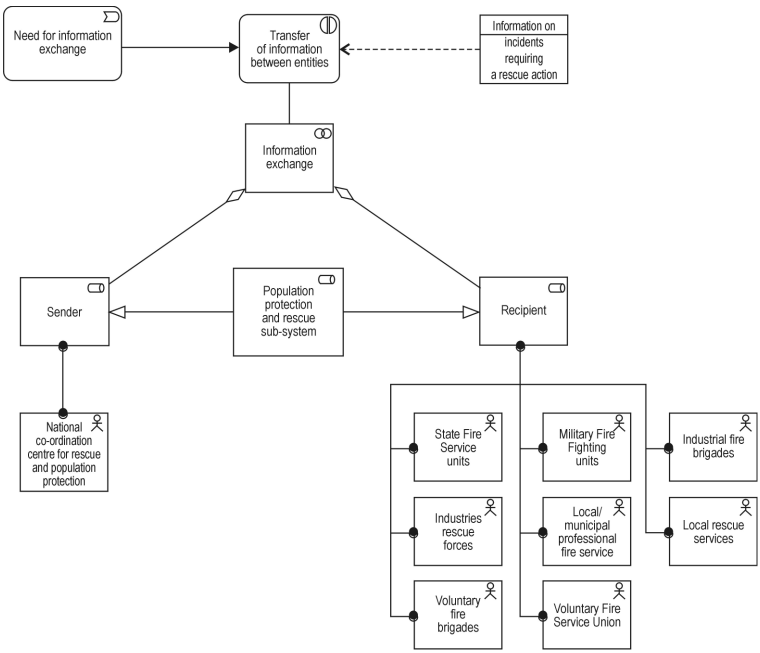


**Figure 19.4.** Exchange of information related to events requiring rescue actions

Source: Own elaboration.

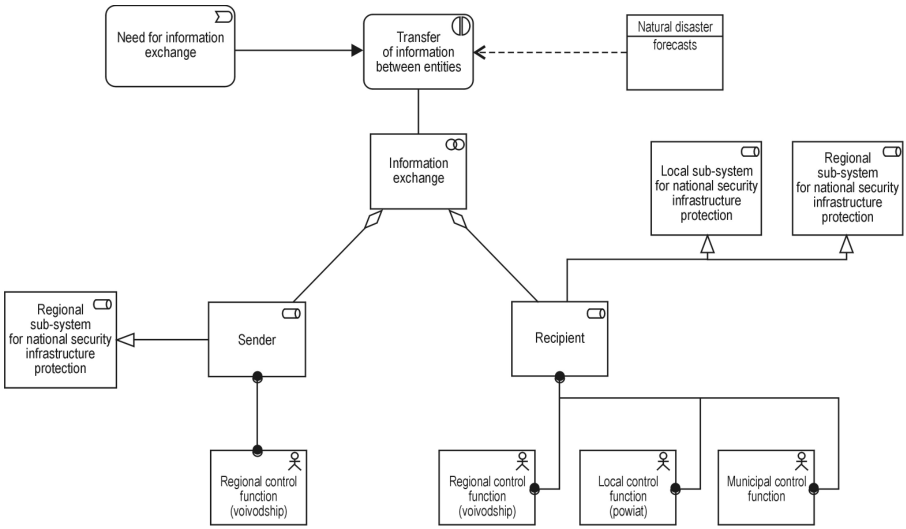


**Figure 19.5.** Exchange of information related to the natural disasters forecast
Source: Own elaboration.

## 19.2.2. Business requirements

The IT tools and solutions being currently in use in Poland are incapable of meeting the challenges associated with the identification and analysis of complex threats to national security. The architecture of the platform for the exchange and analysis of the national security threat-related data presented hereunder is intended to eliminate the existing limitations. It was designed with the aim of meeting the main business requirements, such as:

1) creating one source of data, systematized with respect to the contents and providing secure access to this contents for many entities composing the NSS RP and their authorized representatives,
2) integrating intelligence data from different sources (intelligence areas: human, electronic, measurement and signature, images, geospatial and technical, cyber, financial),
3) creating a reference data repository for key national security issues, to unify analyses conducted by different entities,
4) facilitating the browsing of unstructured data accessible in open sources for the purpose of the national security issues exploration,
5) facilitating multi-aspect analyses initiated to identify opportunities, challenges and threats, as well as to assess their impact on the national security of RP,
6) facilitating the work on forecasts based on data captured and prepared to support the process of decision-making in the field of national security assurance,

7) facilitating the system adaptation to quantitative and qualitative changes in data and to reference data changes (e.g. definitions of threats, protected value, security assessment criteria, etc.),
8) facilitating the automation of the process of identifying interdependencies between data describing different objects capable of affecting the national security level,
9) facilitating the process of feeding the system with structured and unstructured data originating from sources of a diverse nature and intensity, including data streaming (e.g. audio, video, etc.).

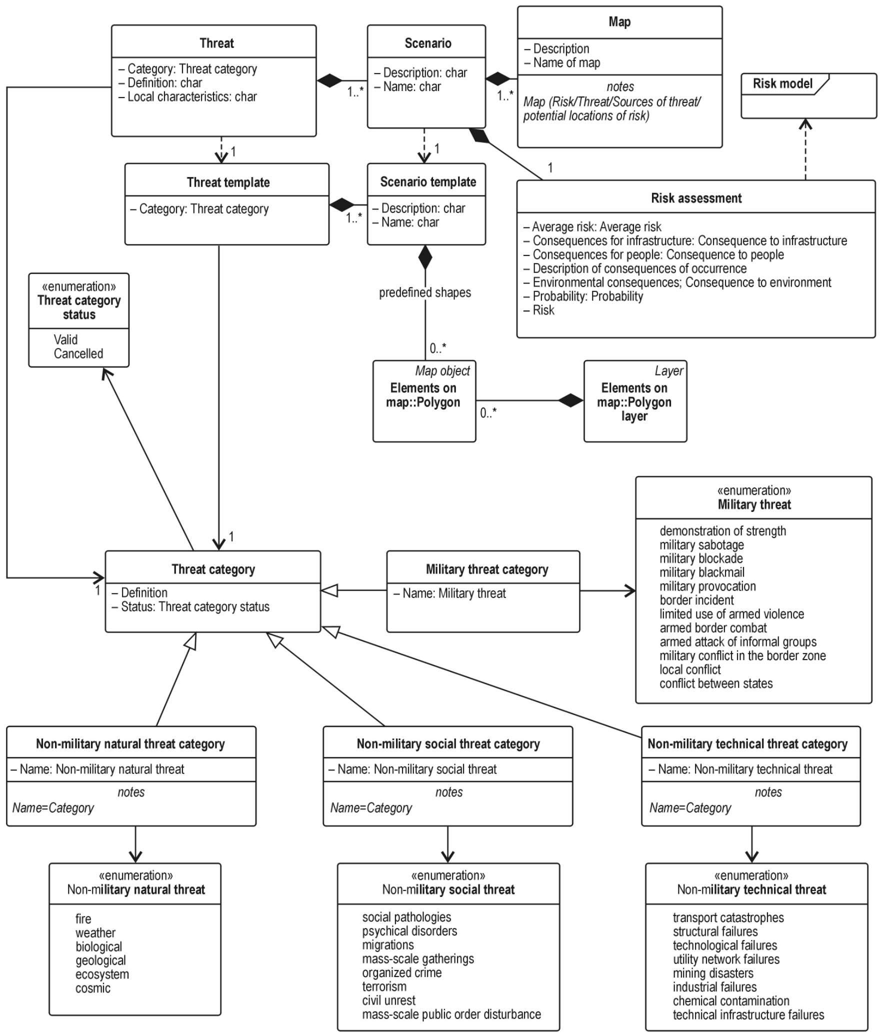


**Figure 19.6.** A model of threats to national security of the Republic of Poland

Source: Own elaboration.

In addition to meeting the above-listed business requirements, the system needs to deploy a model of threats to national security and a risk assessment model presented in Figure 19.7.

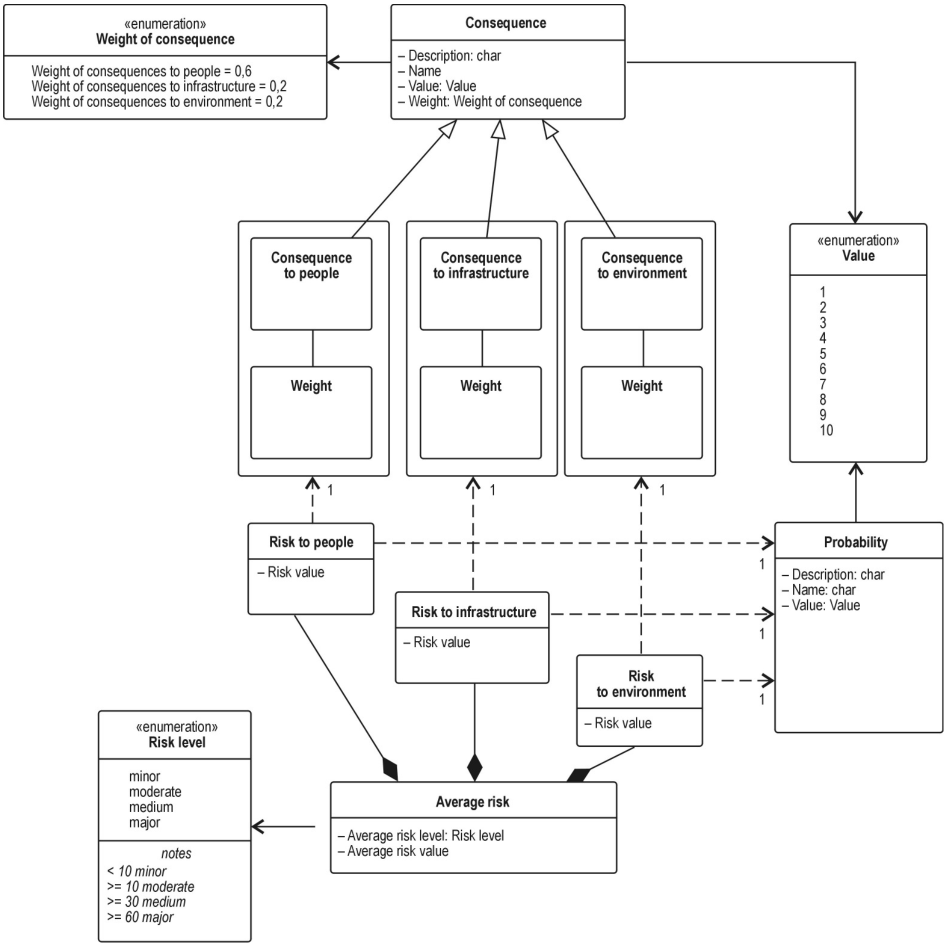


**Figure 19.7.** A risk assessment model

Source: Own elaboration.

## 19.2.3. System functional requirements

In order to meet business requirements, the platform for data integration and analysis has to provide standard functionalities, so as to enable at least:

1) gathering and managing a large volume of structured and unstructured data, with the required level of security and quality;
2) integration and management of data originating from all relevant sources;

3) data analysis and visualization, as well as detecting and analysing data interdependences;
4) real-time processing and analysing data streams;
5) reference data management;
6) developing applications, as well as controlling the system and its sub-systems;
7) generating and sharing the following reusable elements: analytical functions, schemes, tool sets and other artefacts enabling prompt delivery of valuable information required in decision-making processes.

## 19.3. System architecture

The section below presents the high-level aspects of the architecture proposed for the platform intended to integrate and analyse threat-related data within the National Security System of the Republic of Poland. The main objective is to design an architecture which would cover all of the business requirements that have been specified and provide an adequate set of tools capable of delivering analytical outcomes to be used as a basis for identifying opportunities, challenges and threats, as well as their potential sources and estimating the probability of their occurrence. The platform toolset should comprise components for deployment of the best and proven solutions for such areas as Data Warehousing, Data Integration, Data Quality Management, Big Data, Business Intelligence, Data Mining, Stream Computing, etc.

The solution should ensure a high quality and accessibility of data, while providing scalable components for reporting, creating dashboards and performing statistical computations based on data gathered within the platform. It should be noted that the general architecture of the analytical system proposed here is definitely different from typical transaction system architectures [Kimball, Ross, 2002]. The design presented here envisages the user-system interaction to occur mainly via series of queries to get and process data related to circumstances, processes and other analytical issues identified as relevant to the NSS RP.

### 19.3.1. Platform architecture layers

Below, a view of the logical architecture proposed for the solution discussed is presented. Seven principal layers are distinguished in the model (Figure 19.8).

1) data sources;
2) data provision;
3) highly scalable data stores;
4) data analysis and decision support;

5) system control;
6) design and development tools;
7) common presentation interface.

The most important of them are discussed below.

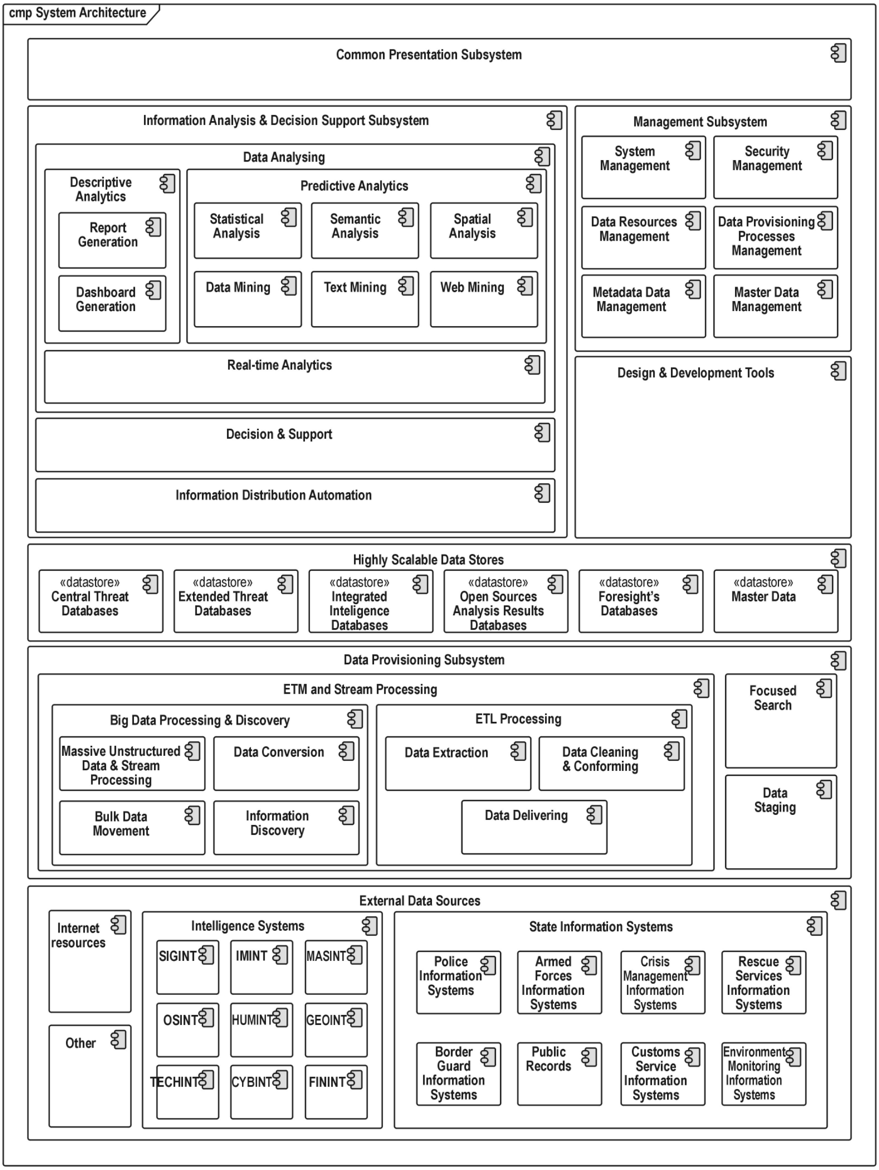


**Figure 19.8.** The architecture of a platform for the integration and analysis of threat-related data in the national security system

Source: Own elaboration.

### 19.3.2. Data sources

The platform will use the following sources of data: domain specific systems and expert systems operated by various actors of the NSS RP (e.g. the Army, the Police, rescue services, the Border Guard, the Customs Services, environmental protection services, emergency response centres, etc.), data streaming sensor networks (e.g. video, audio, electromagnetic signals, data from the measurement of: concentrations of chemical substances, radiations, water level in rivers and storage reservoirs, etc.), systems providing graphic data (satellite images, aerial photographs), public registers, critical infrastructure security support systems, telecommunication network security systems, intelligence and counterintelligence support systems (civil and military), open sources (websites and forums, announcement portals, e-mail based groups, Facebook, Twitter, Instagram, on-line shopping platforms, etc.), as well as many other unmentioned systems capable of delivering potentially valuable inputs. The above-listed sources deliver a variety of structured, semi-structured and unstructured data. This situation gives rise to a number of technical challenges associated with the need to prepare data to be used in decision-making processes.

### 19.3.3. Feeding data into the system

Data are fed from their sources into the system repositories by means of a data feeding sub-system. They are subject to numerous transformations performed by means of specialized tools and algorithms within this layer. The purpose of these activities is to convert raw data into a form suitable for further analytical processing.

The data provision layer consists of three main components:

1) big data processing sub-system – responsible for the unstructured data mining and conversion into an analytical form, as well as for operations of massive data transfer to non-relational repositories.
2) ETL sub-system – responsible for extracting and transforming structured data.
3) A focussed search sub-system – responsible for browsing the Internet in search of websites satisfying pre-defined predicates.
4) A staging subsystem – responsible for temporary storage of data extracted from a source system, before feeding them into analytical sets.

The following data collection mechanisms can be distinguished:

1) cyclical loading – for structured, slowly changing data;
2) on-line loading – directly from source systems (push or pull mode); data is accessible in the analytical system at the same moment when entered in the source system;

3) loading structured content from non-relational to relational repositories based on pre-defined algorithm of extracting data entities from text sources, images and video sequences;
4) source data enrichment with analytical results.

### 19.3.4. Scalable mechanisms for analytical data storage

The data storage tier is responsible for keeping data in central threat databases, extended threat databases, integrated intelligence databases, databases with open source analysis results, foresight databases, master databases and rendering these data accessible to analytical tools.

Considering the volume and the heterogeneous nature of data kept in these collections, highly scalable storage mechanisms should be used, such as:
1) NoSQL – allowing the storage of: images, records of signals, data streams, time series, text and other unstructured data,
2) relational databases – to store data in the form of analytical structures (data warehouse models, data marts),
3) In Memory Data Grids – to store data in RAM, in order to accelerate real-time analyses of large data volumes.

### 19.3.5. Data analysis and decision support tools

Owing to analytical applications providing standard functionalities, the need to develop complex data analysis algorithms from scratch is avoided. The data analysis and decision support layers comprises the following:
1. A descriptive analytics sub-system – responsible for providing reporting mechanisms.
2. A predictive analytics sub-system – responsible for the analysis of data in order to identify patterns and dependences within them; it comprises such elements a statistical analysis, text mining (including www exploration, e.g. analysis of publications on illegal actions), semantic analyses, spatial data mining, weather data analysis, analysis of contamination and epidemics propagation, analysis of social networks (including analysis of relationships between people and organizations), etc.
3. A sub-system for the real-time analysis of data – responsible for analytical on-line processing of streaming data.
4. A decision support sub-system – responsible for performing the pre-defined processes of requesting and generating potential scenarios and action plans for decision makers.

5. An information distribution automation sub-system – responsible for delivering event notifications, results of analyses or pre-defined cyclical reports to pre-defined recipients.

## Conclusion

The purpose of the research work presented in this paper was to develop a generic model of a platform intended for the exchange of threat-related data between the members of the NSS of RP. The first section of the paper contains some fundamental considerations on the concepts related to national security. They are a starting point for the process of specifying the requirements regarding the platform for integration and analysis of data on threats to national security. These requirements, as well as conceptual models for threat description and risk analysis are presented in the next chapter of the article. The analyses performed in the course of the research work enabled us to present a proposal of an architecture allowing for the use of modern IT methods and tools in order to provide comprehensive support to decision-making processes related to the identification and assessment of threats to national security. Through the merger of data originating from various source systems and with the best Data Warehousing, Data Integration, Master Data Management, Big Data, Business Intelligence, Data Mining and Stream Computing solutions used, the system design will enable multifaceted analyses of the impact of many different factors (circumstances, events) on national security in the broadest meaning of the term. Consequently, the practical implementation of the solution proposed in the study will contribute to an improved condition of Poland's national security through thorough improvement of analytical, information and decision-making processes occurring in the state.

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Chapter 20

# Assessment of the Scrum approach for the realisation of mobile application development projects not consistent with scrum assumptions

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## Introduction

The successful development of information systems undoubtedly requires a proven and effective project management approach. Therefore, over many years a few types of approaches and a numerous number of methodologies have been designed. The creation of new methods for information systems development is dictated not only by searching for solutions enabling faster software development with maintaining the high quality of IT products. It also results from the criticism of earlier project management approaches to software development, mainly classical ones [Nilson, 2015, p. 26].

The traditional project management approach is still by far most commonly used [Kerzner, 2011, p. 320]. The reason for the widespread classical approach to IT projects indicated by [Fredrikson, Ljung, 2011, p. 47] is that it is utilised by large organizations responsible for quality assurance and certification, such as PMI (Project Management Institute) and IPMA (International Project Management Association). Classical methodologies like Prince2 (Projects In Controlled Environments), PMBOK (Project Management Body of Knowledge) or Six Sigma are strongly connected with the waterfall project lifecycle where particular stages, such as analysis, design, development, integration and testing and implementation are realized sequentially. Such a concept makes it easier for a project manager to run the project [Jurison, 1999]. Unfortunately on the other hand it makes it difficult for the client to evaluate the progress of work [Abdel-Hamid et al., 1999]. Requirements have to be defined at the beginning of project, and the costs of making changes or fixing errors are very high [Mathiassen, Napier, 2014]. Moreover, methodologies based on a classical approach concentrate mainly on the creation of documentation that [Charvat, 2003, p. 127] highlights as their key disadvantage. The issues connected with waterfall circle resulted in the invention of a spiral project lifecycle [Wysocki, 2009, p. 329], where planning, documentation and development stages are combined in iterations.

The classical approach is challenged from several directions [Fredrikson, Ljung, 2011, p. 47; Mahadevan et al., 2015]. The key reasons are connected to the previously mentioned disadvantages and restrictions of the traditional approach. Another important factor is the constant change in technologies that evolve within computing based on open standards and Service-Oriented Architecture (SOA). SOA and mashups enable us to develop applications and systems by combining interoperable services in a loosely coupled manner. They offer more flexibility, lower costs to reusability and increased productivity [Ayed et al., 2011]. This is achievable mainly due to service reusability and the possibility to implement cooperation between already available components. The use of an internet network for SOA has led to the emergence of Web-Oriented Architecture (WOA), assuming cooperation between far distant services. Moreover, the reliance of Web 2.0 applications on SOA extended WOA into Web 2.0 Service Oriented Architecture [Wymer, 2007], where remote components available for integration are called mashups. During recent years, the role of mobile applications has grown significantly with the emergence of powerful mobile devices. Accordingly, for such systems SOA has evolved into Mobility-aware Web services (MWS) as Mobility-aware service oriented architecture (MSOA) that has been distinguished by [Serhani, Benharref, 2011, p. 345–352].

Projects that rely heavily on modern technologies, SOA and its enhancements are often realized in relatively rapidly changing environments. This makes it particularly difficult to plan projects and produce IT systems [Cerpa, Verner, 2009, p. 130–134] and requires flexible project management solutions. In such a situation, the classical approach is not appropriate and software projects would typically be over schedule, exceed budget and often fail to meet requirements. In order to address this problems the Agile philosophy, presented in Agile Manifesto (agilemanifesto.org/iso/en/) was introduced and is currently associated with the portfolio of Agile methods. The Agile philosophy promotes primarily informal project realisation with minimal documentation and a strong emphasis on verbal and social communication within the Development Team [Valencia et al., 2007, p. 11–22]. Importantly in contrast to the classical approach, the Agile concept includes the possibility to modify the requirements of a system under development during the course of the project to consistently reflect the current expectations of the client and users [Chin, 2004, p. 4]. This is mainly achieved by the production of fully functional parts of the system during short iterations while planning the next system behaviours at the beginning of each iteration. There are many more determinants for project realisation in accordance with the Agile philosophy widely presented in literature on the subject [Strode et al., 2008; Chasalow, 2008; Mahadevan et al., 2015].

The project that served as the basis for this paper concerned the development of a mobile system for students and their faculty schedule for various platforms starting with Android. The project involved a few factors that indicated that it should be realised using the Agile concept. First of all, only the main requirements were known at the beginning of the project, as the list of behaviours was strongly related and adapted with technical possibilities to import data from the main planning system website. Moreover, the mobile system was to be built in a flexible SOA way to allow data exchange for different mobile platforms as well as web version of the application. Therefore, the risk of changes in the technology used also had to be taken into account.

Mentioned project realisation determinants justified the use of the Agile philosophy and one of its methodologies or frameworks. Various methodologies and concepts were analysed such as: Agile Modelling, Agile Unified Process (AUP), Agile Data Method, DSDM, Essential Unified Process (EssUP), Extreme programming (XP), Feature Driven Development (FDD), Open Unified Process (OpenUP), Scrum and Lean Software Development. Finally, the Scrum framework was chosen for its rigorous verification in practice and because it is the most popular Agile approach [Overhage, Schlauderer, 2012]. Furthermore, most of the companies that switch to the Agile management of IT projects mainly choose Scrum (www.scrumalliance.org/why-scrum/who-uses-scrum).

As with every Agile methodology, the Scrum framework has a few assumptions and artefacts explained in detail in its guide [Schwaber, Sutherland, 2013]. Many of them were identified as prohibited to modify. The specifics of this project to develop a mobile system caused many conflicts with Scrum assumptions. An explanation is outlined in Table 20.1.

**Table 20.1.** Specificity of project realisation in accordance with Scrum assumptions

| Scrum assumption | Conflict during project realisation with Scrum assumption |
|---|---|
| All Scrum members have to participate in daily meetings and cannot participate during Sprints in other projects. | Development Team members were engaged in the project as their additional job with only periodic availability. |
| There has to be a Daily Scrum as a 15-minute time-boxed event for the Development Team to synchronize activities and create a plan for the next 24 hours. | Therefore there was no possibility for daily meetings and the number of participants could change in time according to participants availability. Moreover communication had to be remote. |
| Once a Sprint begins, its duration is fixed and cannot be shortened or lengthened. | As the availability of Developer Team members during Sprint realisation could dynamically change, the possibility to extend the Sprint length should be acceptable. |

| Scrum assumption | Conflict during project realisation with Scrum assumption |
|---|---|
| Scrum Teams are self-organizing and cross-functional, no one even the Scrum Master tells the Development Team how to turn Product Backlog into releasable functionality. | Due to loose cooperation between team members during Sprint there was a noticeable need for a Sprint Manager role. |

Source: Own elaboration.

According to Table 20.1, the partial and dynamically changing availability of Development Team members results in a major diversion from Scrum assumptions. Furthermore, the occurrence of breaks in the project was also considered as acceptable.

With respect to this project, the aim of the study was to adapt the Scrum framework for IT projects not consistent with many of its assumptions. Besides usefulness of proposed solution was assessed. This enabled us to verify the research hypothesis that the Scrum framework can be adapted for the successful execution of "ad hoc" type projects. An "ad hoc" project is understand as a project with no day to day systematic realisation. Should the modified Scrum approach be positively verified, the proposed project management solution will be valuable for practitioners to carry out software development projects of an "ad hoc" type.

The second point of the paper presents research methods used for creating an approach and verification in conjunction with the outlined research hypothesis. The third point of the paper presents the study results and a discussion regarding their significance, particularly from the perspective of practical application.

## 20.1. Research methods

Adapting Scrum is justified according to the conviction that is not possible to create one general project management theory due to the vast differences between project types and contexts [Engwall, 2003, p. 789; Remington, Pollack, 2007]. SMEs in particular represent a low degree of standardisation and specialisation regarding project management and prefer lightweight solutions and frameworks [Ghobadian, Gallear, 1997, p. 132; Turner et al., 2010, p. 744]. Additionally, cultural differences have an impact on the way a project is run especially from a team interaction perspective [Sutharshan, Maj, 2011, p. 12–22].

The aim of the paper is to propose a verified project management approach for "ad hoc" types of projects. Therefore for its development, hypothesis verification and final version, a multi-method research approach of qualitative field data was used.

A modified Scrum approach was designed with the use of modelling, observation and action research methods as part of the experiment. The Development Team during a preliminary meeting discussed the specifics of the project in the context of a Scrum framework. The distinguished differences have already been presented in Table 20.1. A brainstorm session led to the conceptualisation of a Scrum approach designed and formalised by modelling techniques.

The proposed project management approach for "ad hoc" types of projects was developed during an experiment connected with the production of a mobile system. Therefore, the solution was implemented as a project management approach for developing a mobile application and distributed services for monitoring and managing course and consultation schedules. The system was designed for students and academic staff and its main functions were to provide information about teaching and learning plans with the possibility to introduce personal modifications in the schedules.

The IT project was strictly integrated with the observation of tasks to detect both problems in project execution and any eventual inefficiency. The Scrum Master was responsible for conducting appropriate monitoring actions. Apart from observing the course of the project, the Scrum Master gathered appropriate research data with respect to the efficiency of the project execution via regular structured, in-depth interviews with Development Team members. As an action research, created approach was constantly adapted by the Scrum Master. It was performed in cooperation with the Development Team to reflect monitoring and interview results.

The practical implementation of the project management approach allowed for its validation. The validation methodology consisted of two elements. First of all, the planned and actual timing of the project was compared to check for variations. Such data was collected for Sprints and analysed in accordance with the project specifics, where it was acceptable to extend the length of the Sprints and even make project breaks. Secondly, structured in-depth interviews with Development Team members were conducted to obtain their assessment of the adapted Scrum project management approach. Team members assessed the approach from two perspectives: the efficiency of the software development project and the quality of final product.

The validation results for the proposed approach allowed us to verify the research hypothesis that a Scrum framework can be adapted for the successful realisation of "ad hoc" types of projects. The study results and discussion on their practical implications are presented in the third point of the paper.

## 20.2. Research results and discussion

The result of the brainstorm sessions carried out by Development Team, regular observations of project execution and action research resulting in the constant adaptation of the mobile system development process according to ongoing requirements led to a modified Scrum approach for software development projects of an "ad hoc" type. The key element of this solution is the transformation of Scrum's Sprint execution as presented in Figure 20.1.

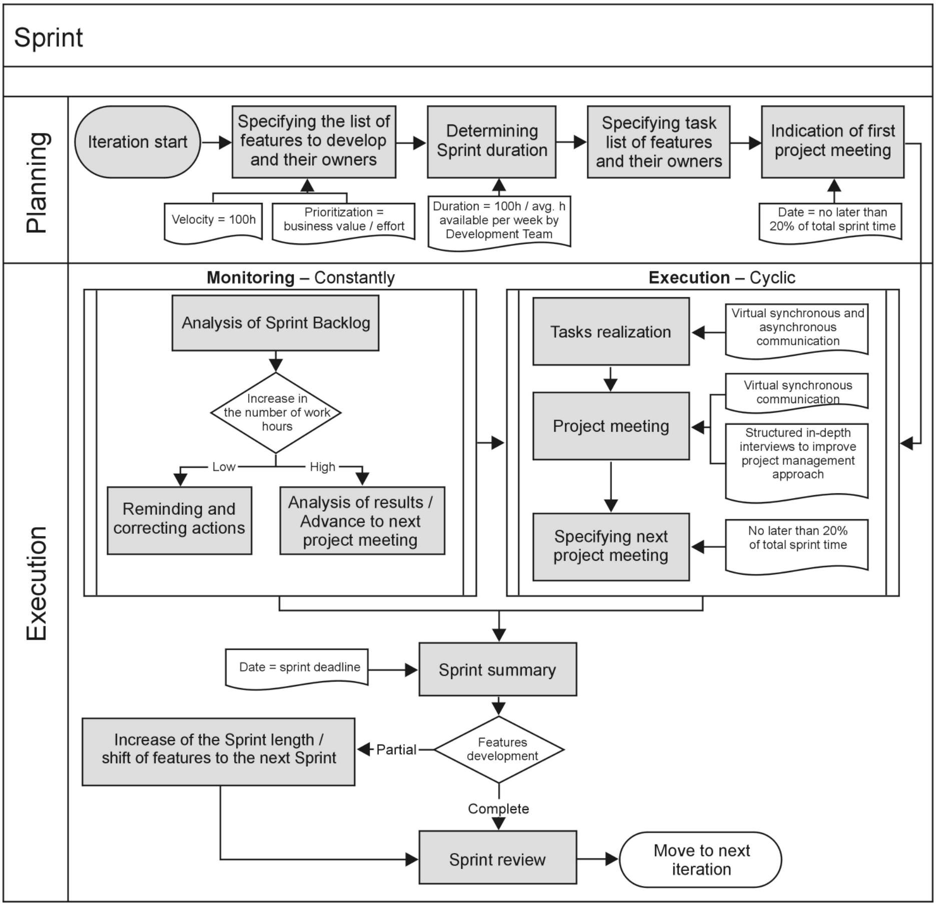


**Figure 20.1.** Process of project realisation for software development projects of an "ad hoc" type

Source: Own elaboration.

According to Figure 20.1 both major and minor changes were introduced. First of all, the list of developed features was based on their duration. This goes against the relative system generally accepted for Scrum [Harb et al., 2015] such as the Fibonacci values. Features were chosen in accordance with their priority measured as a quotient of their business value relative to their effort. The higher the quotient value, the higher the priority of the feature. Such a prioritisation system is consistent with the Scrum approach. Finally, the list was limited to 100 hours of velocity. In addition, as project members were only partially available, the maximum Sprint time was defined as 10 weeks in contrast to Scrum's 30 days. The justification of such a change is to mitigate the risk that very few developmental steps will take place during Sprints because of the limited availability of particular Development Team members. On the other hand, a Sprint limit had to be defined to rule out the possibility of overextending the Sprint. In a situation where the team might not have 100 hours of velocity during the 10 week period, an expansion of the Development Team would be required. Therefore, the Sprint duration was calculated with the formula 100 hours/ average available hours per week by the Development Team.

An important determinant of the project was the lack of possibility for daily Sprint meetings as Development Team members participated in the project as an additional job (Table 20.1). Therefore, project meetings were organised periodically and decided on during the previous meeting (Figure 20.1). To ensure an adequate number and frequency of project meetings, they had to be planned no later than the following 20 percent of the total Sprint time. Due to the varied time availability of the Development Team members, the precise date and time was jointly determined a few days before the initial date and the process was coordinated by the Scrum Master. Beyond that, it was acceptable that not all team members would participate in a project meeting if it was not possible to find a suitable date for all of them.

Development Team members were geographically dispersed and f-2-f communication between them would require significant traveling time to arrive at the meeting place. Usually that time would be substantially longer than the duration of the project meetings. To facilitate communication and allow for more flexible project meetings, virtual communication was used. Asynchronous communication was mainly utilised with tools such as social services groups during task realisation. Communication during project meetings was more interactive thanks to synchronous solutions like video-conferencing.

It was crucial for the mobile system development initiative to constantly update the project management approach. Therefore each execution cycle contained an appropriate activity at the end of the project meeting (Figure 20.1). During structured in-depth interviews with Development Team members, the Scrum Master asked three questions:

1. Which project management activities do you find the most beneficial?
2. Which project management activities do you find the least beneficial?

3. What other actives would you integrate into the project execution process to make it more efficient?

The answers to these questions resulted in the major modification to the Scrum Sprint according to Figure 20.1. Additionally, it was discovered that improving project management should not only be done at the stage of the Sprint review as is assumed in the Scrum approach but instead should be performed periodically during project meetings.

The previously mentioned and justified lack of Daily Scrum resulted in significant changes to the project monitoring process as presented in Figure 20.1. First of all, the Scrum Master was responsible for those tasks and fulfilled an additional role as a kind of project manager. This is completely inconsistent with Scrum assumptions where the Development Team is self-organised [Schwaber, Sutherland, 2013]. The Scrum approach assumes the daily monitoring of remaining work hours. Such a rule was not applied in this case. This was dictated by the different work patterns represented by particular Development Team members according to their availability. Leaving the progress review until the next meeting seemed to be a risky solution. Therefore, team members were required to systematically update their working time for particular dates in the Sprint Backlog. This is opposite to the Scrum approach where work hours for particular dates are set in the beginning of the Sprint and during its execution the values are decreased according to the work performed. The Scrum Master analysed that document on a daily basis to assesses the increase in the number of hours for individual tasks and Development Team members. If the increase was relatively high, the Scrum Master analysed the results and if he found it appropriate he could then decide to proceed to the next project meeting. A large increase in the number of hours was approved if the value for the actual week was much higher than might result from the average number of available hours per week to the Development Team as calculated at the beginning of the Sprint (Figure 1). If the increase in the number of hours was low, appropriate remaindering and correcting actions were conducted by the Scrum Master, such as: motivating team members, replacement of team members or extending the Development Team.

In accordance with Scrum, the Sprints ended with a Sprint summary and Sprint review (Figure 20.1). In this respect, one important modification was introduced. When only a partial implementation of the specified features had occurred, it was permissible to increase the length of the Sprint. Such a solution is not acceptable in classical Scrum. The lack of daily cooperation between the Development Team members, their periodic and unpredictable availability posed a significant risk to the positive outcome of the Sprint that would end up with some of the features of the Sprint left unfinished. Therefore, it was difficult to guarantee the completeness of all the features before the Sprint deadline. Including additional, reserve time in Sprints is viewed as a bad practice for Scrum [Batra et al., 2010]. On the other hand, shifting features to the next Sprint could lead to a negative outlook on the project progress. Therefore, the Scrum Master could decide to increase the length of the Sprint in the case of minor deviations from the plan. In cases of major time deviations from the Sprint plan, the execution of features would be shifted to the next Sprint and then during the Sprint Review an appropriate solution for preventing this kind of situation had to be put in place in cooperation within Development Team. This modified Sprint process definitively expanded the role of the Scrum Master compared with classical Scrum. Moreover, his efficiency in project coordination is a highly significant factor in successful project execution.

As described previously and presented in Figure 20.1, during Sprint meetings with the help of structured in-depth interviews with Development Team members, the adapted Scrum approach was constantly assessed and updated to the "ad hoc" specific of the project. This was an important factor for validating and assuring the quality of the proposed project management solution. In order to validate the final version of the approach, a questionnaire was drafted and questions directed to Development Team members after the end of the project. Both the questions and answers are included in Table 20.2.

**Table 20.2.** Questions and answers connected with the approach verification

| Question | Answers |
|---|---|
| Are the mechanisms for Sprint planning appropriate? | Yes |
| Do the formulas for calculating Sprint duration allow for precise measuring? | Yes |
| Does the lack of Daily Scrum have a negative impact on the project realisation? | No |
| Do the virtual synchronous and asynchronous communication solutions allow for effective project communication? | Yes |
| Does the possibility to increase the length of the Sprints have a negative effect on the effectiveness of the project execution? | No |
| Does not obliging Development Team members to participate only in one project have a negative impact on the project execution? | No<br>Minor impact – additional time is required to introduce new members with the project. |
| Does the monitoring system allow to detect exceptions? | Yes<br>Not fully – it allows to provide adequate number of team members, but not the completeness of test cases. |
| Are the project templates appropriate to carry out project tasks? | Yes |

Source: Own elaboration.

The Development Team members highly rated the modified Scrum approach in the context of its utilisation for "ad hoc" types of projects (Table 20.2). Minor reservations were connected with allowing changes in Development Team membership. The additional time required to introduce new members to the project having a negative impact is entirely understandable and is unavoidable. The solution to reduce such a negative impact is to document the project well, have communicative team members, and always ensure that there is at least one person familiar with the topic. More significant comments were addressed to the monitoring system. Although it was generally rated positively, one of the Development Team members pointed out that changes in the Development Team had a negative effect on the quality of test cases and therefore the quality of software and number of bugs. New team members do not adequately define test cases for existing functionalities and code, mainly due to their limited system knowledge. It seems to be not only the issue of the project management approach but also the quality of testing. In this context, it would be appropriate to implement one software development approach such as Test Driven Development (TDD) or Design Driven Testing (DDT). TDD and DDT stipulate that first tests be created for features and then code is written, this ensuring more detailed software testing even when the project team members change.

The designed approach was assessed positively by the Development Team members. Therefore, the original hypothesis was confirmed that the Scrum framework can be adapted for the successful realisation of "ad hoc" types of projects.

The modified Scrum approach has some practical implications. First of all, it is suitable for the successful realisation of projects based on developers and enthusiasts where the project tasks are carried out outside of work hours. It is also particularly valuable for firms to conduct smaller projects. With the help of the proposed project management approach it is possible to delegate employees to more than one project. The biggest beneficiaries would be firms that already develop software in an agile way, particularly using the Scrum framework.

In the context of the designed approach there are still some aspects that should be studied. First of all, the project was relatively small with no high time pressure. Same research might be conducted on a bigger project of with a higher time pressure. Also the role of the bottleneck cannot be underestimated. It is very important to always have at least two people in the project capable of running a task. What if only one Development Team member has appropriate skills and he drops out?

## Conclusion

The study positively verified the research hypothesis that the Scrum framework can be adapted for the successful execution of “ad hoc” types of projects. An hoc project is understood as a project with no systematic day-to-day running. Hypothesis verification was conducted by appropriate research among the Scrum's Development Team with the use of structured in-depth interviews.

An appropriate customised Scrum approach was designed for the project to create a mobile system in specific conditions. The crew was engaged in the project as their additional job with only sporadic time available to the project. Therefore, there was no possibility for daily meetings and the number of participants could change in time according to their availability. Moreover, the communication had to be remote. Therefore, a modified Scrum approach was created by making some major alterations to the Sprint realisation. The proposed project management solution was constantly updated during periodical interviews with the Development Team. The most important changes to the classical Scrum's Sprint execution were:
– specifying the list of developed features based on the calculation of their duration,
– extending the maximum Sprint time to 10 weeks,
– periodically organising project meetings whose dates were always decided during earlier meetings,
– conducting project meetings with the use of asynchronous and synchronous virtual communication,
– constant update of the project management approach during periodical project meetings,
– Scrum Master responsible for managing Development Team tasks as a kind of project manager,
– Scrum Master on daily basis analyses Sprint Backlog to assesses the increase in the number of work hours for individual tasks and project team members. If the increase is relatively high he could decide to proceed to the next project meeting. If the increase in the number of hours is low then appropriate motivational and correcting actions were conducted,
– Scrum Master could decide to increase the length of the Sprint in the case of minor deviations from the plan.

The positive assessment of the designed approach, also confirmed by the verified research hypothesis, has some important practical implications. It allows us to acknowledge the proposed project management solution as useful for the successful realisation of projects based on developers and enthusiasts whose project tasks are realised during their spare time which is difficult to predict. It also means that it is valuable for firms that would like to be able to assign employees to more than one project.

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Chapter 21

# Supporting knowledge transfer in oceanographic museums. Scope of the problem and survey of solutions

*Jakub Swacha*

## Introduction

Knowledge transfer is a process of primary importance for modern organizations. When it is effective, knowledge from one part of an organization is applied to activities in other parts, past experience is exploited in current activities and planning for future, and people from various parts of the organization collaborate to create new knowledge [Zack, 2003]. Further benefits can be envisaged if the transfer reaches beyond the organization's boundaries.

In this paper we address the problem of effective knowledge transfer in oceanographic museums. We argue that there are three distinct areas in which organizations of this kind are actively involved in knowledge transfer (section 1). We perform a literature survey on recent developments in techniques and related information technologies supporting knowledge transfer to identify 23 solutions that can be applied in oceanographic museums (section 2). Based on own observations from the BalticMuseums 2.0 Plus project which involved knowledge transfer among four oceanographic museums, we indicate applicability of the identified solutions to the respective three areas of knowledge transfer in oceanographic museums, also identifying existing constraints (section 3).

The paper is based on results of a research conducted with the financial support from the European Union within the BalticMuseums 2.0 Plus project.

## 21.1. Knowledge transfer in oceanographic museums

### 21.1.1. Knowledge transfer and the factors that affect it

Knowledge transfer can be defined as the process by which an actor or organization acquires knowledge from another one [Cutler, 1989]. Note, though, that the literature on knowledge management provides a number of other, often contradicting definitions for this term [Paulin, Suneson, 2012], mostly narrowing down who or what can partake in the process, limiting the number of participants, or requiring certain results from the transfer (see [Becker, Knudsen, 2006] for a thorough critical discussion of multiple existing definitions).

Although the researchers usually use knowledge transfer interchangeably with knowledge sharing [Paulin, Suneson, 2012, p. 82], some argue that these are not the same, presenting the terms as addressing e.g.:

– various aspects of the same phenomenon (respectively, technological and human) [Krok, 2013, p. 74],
– two types of the same phenomenon (respectively, purposeful communication of knowledge to a known receiver, and less-focused dissemination of knowledge to people who are often unknown to the contributor) [King, 2009, p. 8],
– a general phenomenon and one of its forms (along with knowledge acquisition, dissemination and provision) [Mikuła, 2013, p. 66].

Knowledge transfer may be considered intra-organizational (internal) if all its participants belong to the same organization, or inter- organizational (external) if they do not. The latter may be further classified into downstream (e.g., between a company and its customer), upstream (e.g., between a company and a university), or horizontal (e.g., between competitors) [Becker, Knudsen, 2006, p. 10].

Knowledge transfer meets barriers of various types. Szulanski looks for sources of these barriers in the transferred knowledge (being causally ambiguous or unproven), the source (lack of motivation or perceived reliability), the recipient (lack of motivation, or absorptive or retentive capacity), and the context of the transfer (barren context, arduous relationship between the source and the recipient) [Szulanski, 1996, p. 35]. He also mentions that external transfers may be hampered by confidentiality and legal obstacles [Szulanski, 1996, p. 27]. His empirical findings, based on 271 observations of 122 best-practice transfers in eight companies, suggest that the most important internal knowledge transfer barriers are the recipient's lack of absorptive capacity, causal ambiguity, and the arduousness of the relationship [Szulanski, 1996, p. 37].

Conversely, Krok focuses her research on factors that could affect (positively or negatively) intra-organizational knowledge sharing, identifying 24 of them, and arranging into four categories, grouping, respectively, the factors depending on: employee themself, organization and co-workers, knowledge itself, and employee, organization and knowledge altogether [Krok, 2013, p. 82]. Her empirical findings, based on a survey of 309 hospital workers, suggest that the most important of those factors are: expecting knowledge transfer benefits to be higher than costs, feeling self-confident and bold, having the sense of reciprocity, considering own knowledge to be of high value, feeling that someone (a superior or a co-worker) cares about the employee's issues, positive relations with a superior, internal motivation, positive appraisal of the communication system, the knowledge transfer being noticed and appreciated by the management, being open for new experiences, and having no fear of losing the position [Krok, 2013, p. 163–164].

### 21.1.2. The oceanographic museum context

The oceanographic museums are institutions accumulating significant knowledge resources, both explicit (e.g., information on what is presented to the visitors) and tacit (e.g., information on how the visitors should be guided). As they usually feature aquariums, there is even greater amount of mostly tacit knowledge regarding how the living animals should be kept, fed and bred. Obviously, therefore, the effective intra-organizational knowledge transfer is of primary importance, as losing the knowledge may lead to irreversible substantial losses (e.g., death of exhibited animals).

Also, the inter-organizational knowledge transfer is important, due to the multi-faceted nature of oceanographic museum operation. Apart from its not negligible commercial aspect [Cain, Meritt, 1998], it usually includes visitor education [Packer, Ballantyne, 2010], wildlife conservation [Gusset, Dick, 2011], and scientific research [Lawson et al., 2008]. In these areas, oceanographic museums cooperate with other oceanographic museums and organizations of various types (see, e.g., [Smith et al., 2007; Leus et al., 2011]).

Therefore, we shall distinguish three distinct areas of knowledge transfer that the oceanographic museums are involved in:
1) intra-organizational, among museum employees of various units;
2) inter-organizational, aimed at visitors, of educational nature;
3) inter-organizational, with other organizations of various types, comprising all the aspects of museum operation.

## 21.2. Technological solutions supporting knowledge transfer

### 21.2.1. Supporting transfer of tacit knowledge

The transfer of tacit knowledge depends mostly on communication practices and collaboration [Martin-Niemi, Greatbanks, 2009]. In recent years, a number of technological solutions, that can bring improvement in these areas, emerged and matured [Muszyńska, 2010]. These include personal communicators (e.g. Skype, Google Talk), project management suites (e.g. Redmine, Zoho Projects) and workflow management systems (e.g. CEITON, Kissflow). A growing number of office applications allows for concurrent editing of documents with visual traces of every user's activity (e.g., Google Docs, Prezi).

Mentoring program is an efficient and inexpensive way of transferring knowledge from experienced to novice employees [Bjørnson, Dingsøyr, 2005]. E-mentoring, based on Internet communication technologies, including such as mentioned above, provides an advantage of greater accessibility, as a single mentor can coach a greater number of mentees, and not only physical distance becomes irrelevant, but also time difference (with asynchronous communication tools) [Muszyńska, 2014, p. 13]. It may also eradicate social communication barriers, such as age, race, gender, and religious or political conviction, very probable in face-to-face mentoring [Janasz de et al., 2008].

Communities of practice can be used to facilitate the informal transfer of knowledge as its members have common interests in learning and exchanging experience in their specific area of activity, as they solve similar problems [Hamburg, Marin, 2010]. Virtual communities of practice display the same benefits as e-mentoring, and can be based on popular social network websites [Retzer, Yoong, 2009]. In fact, they can be considered a good base for e-mentoring programs [Lee, Mehta, 2015].

Storytelling can be a powerful tool for knowledge transfer as it puts the transmitted information in a proper context, both being naturally embedded in the story [Martin-Niemi, Greatbanks, 2009]. In on-line storytelling, not only the teller can be in a place distant to the listeners, but the story can also be easily recorded for future use.

### 21.2.2. Enabling access to explicit knowledge

The explicit knowledge resources can be useful only if they are accessible for the users. Today, Internet and intranet portals are the primary tools that allow the users to access information regarding the entire organization, its individual units or project teams, such as news, technical documents, or yellow pages, as well as internal communication channels, e.g. discussion forums.

Managing the portals is made simple thanks to content management systems that allow secure access to content, easy content editing, attaching metadata, revision control, and effective search mechanisms. Their use also enables content modularization and standardization, which, in turn, help to reuse existing content. Typical systems of this type are designed to manage chunks of information, however there are subtypes designed specifically to manage whole documents (document management systems) or multimedia files (digital asset management systems) [Swacha et al., 2013].

Searching capabilities can be augmented with proper assignment of metadata to content, especially those allowing to classify search results according to the used ontologies, taxonomies, or folksonomies obtained via collaborative tagging (see [Martin-Niemi, Greatbanks, 2009]).

### 21.2.3. Fostering tacit-explicit-tacit knowledge conversion

Note sharing tools (such as Evernote or Google Keep), wikis of various kinds, as well as blogs (and video blogs) are convenient tools that, on one hand, facilitate conversion of users' tacit knowledge into explicit form, on the other, enable access to the results of this conversion. They are especially useful in providing an individualized perspective for resources published elsewhere. Such comments can also be attached to resources they adhere to, by document annotation; they are supposed to help the users to understand the content of the document and make it more useful for future tasks [Cobos, Schlichter, 2004].

Knowledge maps, diagrams and storyboards provide tangible graphic form to abstract ideas and allow a generalized view on complex systems and processes. They can also be used as visual directories, revealing missing elements and pointing the user to the relevant resources [Cooper, 2006, p. 54]. A number of software tools is available for devising knowledge maps and diagrams (e.g. Dia, SmartDraw, TheBrain, or XMind), as well as storyboards (e.g. Articulate Storyline or Storyboard That).

Although Szulanski have found that motivation is not the dominant factor deciding about the effectiveness of knowledge transfer, his very own results show that it still is a nonnegligible factor [Szulanski, 1996, p. 35]. Therefore, the motivational power of games can also be exploited to support knowledge transfer. Three examples of such practices are edutainment (educational entertainment), serious games, and gamification. Serious games are complete games designed and used for non-entertainment purposes, whereas gamification is about using selected game design elements (such as points, badges, and rankings) in non-game contexts [Deterding et al., 2011]. The distinction between serious games and edutainment is not so clear or generally agreed; according to Charsky, the former addresses higher order thinking skills, whereas the latter – drill-and-practice lower level skills [Charsky, 2010]. Information technology plays a crucial role here, as games can be implemented as electronic games, allowing for greater visual realism and complexity of rules and game world; also implementing gamification in an organization is much more feasible with adequate software [Swacha, 2014].

## 21.3. Mapping the solutions to respective knowledge transfer areas of oceanographic museums

The technological solutions described in the previous section were mapped to the three areas of knowledge transfer in oceanographic museums, taking into consideration both the character of provided support and specific requirements of the respective areas.

The results are presented in Table 21.1, with '+' denoting suitable solutions, and '–' denoting non-suitable solutions.

**Table 21.1.** Applicability of solutions supporting (I)ntra-organizational knowledge transfer, (E)ducational knowledge transfer to visitors, and (O)ther inter-organizational knowledge transfer in oceanographic museums

| Solution | I | E | O |
|---|---|---|---|
| Personal communicators | + | – | + |
| Project management suites | + | – | +(1) |
| Workflow management systems | + | – | +(1) |
| Collaborative software | + | – | +(1) |
| E–mentoring | + | – | + |
| Virtual communities of practice | + | – | + |
| On–line storytelling | + | + | + |
| Internet portals | + | + | + |
| Intranet portals | + | – | +(1) |
| Content management systems | + | +(2) | +(2) |
| Document management systems | + | +(2) | +(2) |
| Digital asset management systems | + | +(2) | +(2) |
| Collaborative tagging | + | +(2) | +(2) |
| Note sharing tools | + | – | +(1) |
| Wikis | + | +(2) | +(2) |
| Blogs and video blogs | + | + | + |
| Document annotation | + | – | +(1) |
| Knowledge mapping tools | + | + | + |
| Diagramming tools | + | + | + |
| Storyboarding tools | + | + | + |
| Edutainment | + | + | + |
| Serious games | + | + | + |
| Gamified systems | + | + | + |

Remarks: (1) Within common projects. (2) With limited access rights for external users.

Source: Own elaboration.

All of the 23 identified technological solutions were found suitable for supporting intra-organizational knowledge transfer, whereas the restrictions of inter-organizational knowledge transfer leave only 9 solutions (with further 5 to a limited extent) useful for educational knowledge transfer to visitors, and 12 solutions (with further 6 in case of project-based cooperation and additional 5 to a limited extent) useful for other inter-organizational knowledge transfer.

Limitations of applicability of certain solutions for inter-organizational knowledge transfer are mainly due to three factors:

1) direction of the transfer (e.g. educational resources are generally provided by the museum to the visitors not by them to the museum),
2) information security, including confidentiality (restricting access to certain systems and resources),
3) copyrights (restricting external access to certain resources).

Project-based cooperation changes the context as it requires close collaboration on regular basis (within the scope of a project), and although the employees of cooperating organizations cannot be treated exactly as museum's own employees, they are not alien either.

## Conclusion

Knowledge transfer, both intra- and inter-organizational (including, but not limited to visitor education), is a vital factor of oceanographic museums' operation. There is a number of information technology solutions available that can be exploited to support knowledge transfer in various ways. Because of several factors, not every of these solutions is equally suitable for every area of knowledge transfer that the oceanographic museums are involved in.

The future work will be to measure the impact of applying the respective solutions on the effectiveness of knowledge transfer in oceanographic museums.

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Chapter 22
# Building Capabilities for Science and Technology Parks Performance through Area of Innovation Management Systems

*Adam Penkala, Bartłomiej Dessoulavy-Śliwiński*

## Introduction

The aim of the article is to analyse the issues of the construction and implementation of management systems at Research and Development (R&D) units, especially Science and Technology Parks (STPs). Due to the relatively low interest in this subject, the authors try to specify the management of such organizations, as well as make attempts to classify them on the basis of the type of dominant R&D activity, in particular with regard to the implementation of management support systems. In the present study, the authors use the data of the International Association of Science Parks and Areas of Innovation (IASP) and base their research on the results of in-depth interviews performed at 74 units of this type, located around the world. This paper refers to a process approach and process maps in order to determine the direction and manner of the implementation of management support systems at STPs.

## 22.1. The characteristics of the management process at Science and Technology Parks

On the one hand, significant resources dedicated to the creation of R&D centers around the world generate great opportunities for this type of units. On the other hand, they develop new areas of work, which managers of such units must cope with.

Science and Technology Parks are institutions to support high technology firms and other instruments of technology spread. They also help to develop endogenous science and technology [Sanni, Egbetokun, 2009, p. 3]. They are effective vehicles for promoting new technology-oriented firms, facilitating the commercialization of scientific research, and revitalizing regional economies [Zhang, 2011, p. 1].

According to Nauwelaers et al. [2014, p. 4] five key elements that characterise STPs are:

1. A localised economic development goal;
2. A focus on fostering science-industry relationships;
3. A priority placed on innovative and technology-based activities;
4. A provision of value-added services to companies;
5. A property-based initiative.

## 22.1.1. Small resources vs. specialized departments

According to IASP [2011], more than 45% of STPs have 5 or fewer employees who manage the whole park, including technical maintenance department (Figure 22.1). It indicates both a professional specialization of these people, as well as the need to support their work with information systems and use outsourcing to perform the basic project operations.

The majority of organizations consists of the following departments:

- Administration, including Property & Facility Management,
- IT,
- Incubator management,
- Marketing,
- Internationalization,
- Finance & Accounting,
- Management (director).

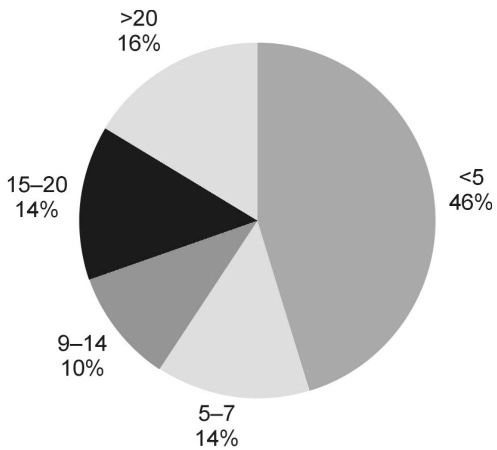


**Figure 22.1.** Question: How many members of full-time staff work in a management team of your park?

Source: [IASP, 2011].

### 22.1.2. Facility Management (FM) software market (functions)

In January 2015, the International Association of Science Parks and Areas of Innovation (IASP) conducted an international survey on STPs experience in choosing the software to manage the park [IASP, 2015].

The analysis showed that 49% of STPs do not use any software to manage this kind of organizations (Figure 22.2). It may be surprising, due to the fact that such organizations have to fulfill high demands to provide professional services in an innovative and often international environment. Among 51% of the parks that possess such a system created their own system or purchased a commercial version; only 10% of them indicated having functionalities related to Facility Management, such as helpdesk or PPM.

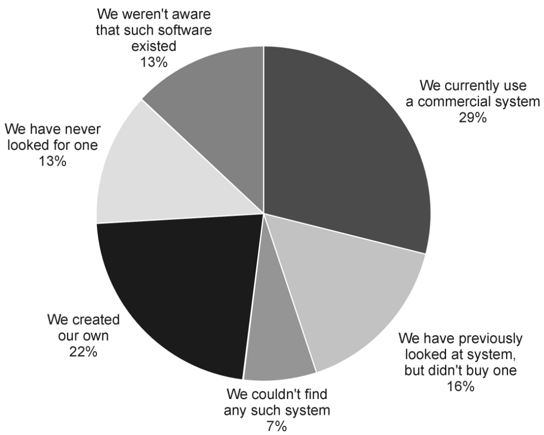


**Figure 22.2.** Question: What is your experience on selecting software designed specifically to manage your park operations?

Source: [IASP, 2015].

## 22.2. Study on functionality of software for STPs

In our study, we examined 74 STPs through in-depth interviews, the organizations were selected all over the world. The interviews were conducted in the majority of European countries and outside Europe. During study visits and teleconferences, expectations for software functionality were collected among managers of parks, incubators, accelerators and research units.

Method used: IDI (In-depth Interviews), Total number of IDI's: 74. Personal onsite meetings and conference calls during the time frame: October 2014 – March 2015.

Number of STPs by country: Norway (2), Spain (14), Poland (12), China (2), Italy (1), Portugal (1), Finland (1), Japan (1), Belgium (8), Luxemburg (1), Pakistan (1), Panama (1), Sweden (2), Turkey (2), USA (1), France (3), Croatia (1), Estonia (1), Russia (12), Brazil (5), Columbia (1), Mexico (1).

Those organizations were classified in accordance with the type of the unit and the dimension of ownership according to:

- Commercial Units,
- City/Province Units,
- Special Economic Zones Units,
- Government Units,
- University Units,
- Other.

The audit determined the most anticipated functionalities of the STP management software. These findings are presented in Figure 22.3.

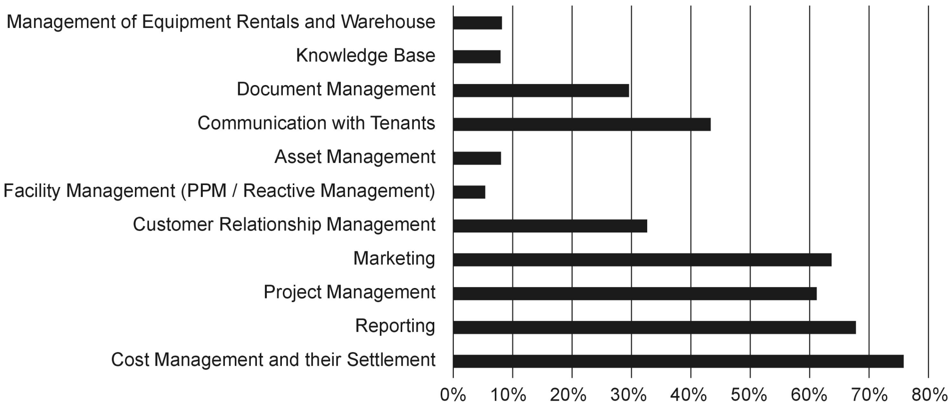


**Figure 22.3.** Anticipated functionalities of STP management software
Source: Own elaboration, based on IDI's (n=74).

Among the above-mentioned functions, more than 60% of STPs indicated Cost Settlement, Reporting, Marketing and Project Management as required in the system. Only 5% indicated Facility Management as an expected functionality.

According to our study of Science and Technology Parks (STP), only 35% of this type of organizations use outside companies dealing with Facility Management; whereas, in commercial buildings such as office buildings or industrial facilities it has become a very common phenomenon. Due to that fact, it is particularly important to build the corresponding competencies in-house.

Taking into consideration the technical aspect, low voltage systems are the hardest in maintaining the infrastructure of R&D. The difficulty in the management ensues from technological advancement of infrastructure, high value and high cost of its maintenance as well as exploitation. An additional challenge is to maintain a specialized R&D infrastructure such as laboratories, data center, etc. This type of infrastructure requires more expertise. Moreover, the technical infrastructure maintenance costs that grow over time devolve on the organizations at the end of the warranty period. Another aspect is the fact that the majority of R&D organizations, in the initial phase of development, possess great financial support from external funds (e.g. public funds for infrastructure development). However, in the long term, such organizations are expected to be self-funded.

### 22.2.1. Features vs. the possibility of implementing

Completed implementation projects in the field of IT implementation in this type of units have usually covered a wide range of functionality. The units pointed to the following problems of implementation:

- limited possibility of application of available IT solutions resulting from the lack of experience in using such systems;
- restrictions resulting from a small human potential of a particular unit in the area of determining the scope and requirements of the user (no possibility for full involvement in the initial phase of the project);
- difficulties in finding a sufficient amount of time required for training users of the system during implementation.

Due to the above-mentioned restrictions, an implementation plan performed in this type of units should include, in the first phase, only the most important modules from the perspective of the organization and its development. The implementation stage should be scheduled in accordance with the AGILE methodology with shortened time sprints of development issues [Ambler, 2013, p. 9].

### 22.2.2. Justification of the choice of functionality to implement

Selection of the functionality in implementation, made by the managers of STPs is dictated primarily by the need to improve the end-user applications and the possibility to automate individual processes. Furthermore, the areas that are the most labor-intensive, from the perspective of the management team, and the one that caused problems that have appeared in the past are indicated. It is manifested by, among others, a large number of implementations related to managing administrative and accounting processes. Only in a few cases, the choice of implementation areas was connected with the strategic objectives of an organization and its long-term strategy for development.

However, units, which want to implement management support systems usually expect too much of the functionality of the software in relation to the possibilities of their application and implementation capacities.

### 22.2.3. Analysis of the specific implementation of IT solutions in STPs

When it comes to the methodological implementation approach, special emphasis is placed on pre-implementation and training stages. This approach provides users with the ability to adapt to the new tools and to change the way particular processes are executed.

A phased approach is based on the effectiveness of implementation, focusing on one internal process, e.g. Facility Management, which takes about 3 months. The value depends on the size of the department and the complexity of the process.

However, in practice, e.g. due to the specific mode of procurement in the public organizations, all implementation phases should be initiated and completed within an established in advance, narrow period. Such assumptions often result in the need to reduce the individual stages to a minimum, usually at the expense of users training stage.

Another factor is the limited STPs flexibility in conducting an appropriate pre-implementation analysis in public tender formula, which defines the boundary conditions in the implementation and the possibility to adapt current procedures for the implemented solution.

STPs diversity means that companies implementing software should not follow common implementations for this type of organization but they should base it on a thorough pre-implementation analysis. However, such an analysis cannot be performed before the final design of the function or the selection of an implementation of existing functionalities.

## 22.3. The evolution of management systems in STPs. Towards the Area of Innovation Management Systems (AIMS)

Information systems allow for the integration of different activities of STPs. They play two roles, namely supporting management processes and support the management of auxiliary processes. Not to mention the fact that, at the same time, they become also a part of the managed infrastructure.

### 22.3.1. Information systems supporting Facility Management in STP

According to the British Institute of Facilities Management (BIFM), the management "is the integration of processes within an organization to maintain and develop the agreed services which support and improve the effectiveness of its primary activities" [BIFM, 2015]; whereas, according to the International Facility Management Association (IFMA), it is "a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology" [IFMA, 2015].

Potential users of the management systems within the scope of Facility and Technical Infrastructure Management expect functionality in different areas, e.g. Space Management, Physical Assets Tracking, Aided Interior Design, Reporting and Breakdown Management (help desk systems), Control and Maintenance Planning, and others. Due to the fact that the real estate and facilities have their own characteristics and differ from each other, it is very important to identify at the implementation stage the needs for infrastructure maintenance and generation of technical solutions.

### 22.3.2. Information systems supporting Customer Relationship Management (CRM) in STP

Taking into consideration the operation of STPs, there is also an opportunity to apply computerization to management processes that rely heavily on relationships with customers, both externally and internally. CRM as a support in such a communication may have different definitions or declared function, but it is worth mentioning here the following definition: "a strategic approach that enables organizations to use internal resources (i.e. technology, people, and process) to manage the relationship with customers for the whole of their lives cycles, in order to create a competitive advantage and improve an organization's performance" [Mohammed, Bin Rashid, 2012, p. 221]. Regarding to Chen and Popovich "CRM applications take full advantage of technology innovations with their ability to collect and analyse data on customer patterns, interpret customer behaviour, develop predictive models, respond with timely and effective customized communications, and deliver product and service value to individual customers" [Chen, Popovich, 2003, p. 677].

The idea of CMR coincides largely with that of the FM area.

In practice, CRM systems find application in supporting management processes, and are expected, especially in situations where numerous processes and interactions with customers take place (both internally and externally). What is more, it becomes particularly important to draw attention to the cost of acquiring and maintaining relationships with customers, increased customer demands, high cost of direct contact or the necessity to build the image of STP units.

To summarize, it can be concluded that both FM systems and CRM tend to integrate resources in order to support the implementation of the basic processes of the organization. Therefore, it is worth pondering over the question whether which area should be more important for STP? However, to answer this question it is necessary to look at the concepts of functioning of individual STPs and their strategic assumptions.

Process map defines and organizes the processes of the organization (Figure 22.4). Process maps are graphic presentations of STPs processes specifications. We can use them to show STP structure and its main activities. Depending on the level of detail of such a map we can talk about process architecture and obtain a general view on process structure or, according to needs, look into processes presenting work course in the STP, sub-processes or actions, which are components of processes [Śliwiński, Gabryelczyk, 2010, p. 13–24].

Information systems supporting the management of FM area have been evolving from systems related to the technical management of technical objects to integrated systems of complex infrastructure management [Śliwiński et al., 2011, p. 434–435]. In fact, these systems are very important and support auxiliary processes in organizations, whose primary objective is to facilitate the management of the infrastructure (building integration surface, laboratories, equipment and research installations, etc.). This unit can be classified as an Infrastructure Driven STP (STP relying on the infrastructure).

Example of the Infrastructure Driven STP is Olsztyn Science and Technology Park, which is an investment of the city of Olsztyn, Poland, co-financed by the European Regional Development Found. Facility area of park is 14 000 m$^2$ and it is focused on real estate and laboratory infrastructure services and rental. Main activities include:

- Commercial real estate services for companies with a stable position.
- The Business Incubator – a space for start-ups, especially new technology companies that can count on broad support services on the way to their own development.
- Laboratories – space equipped with modern infrastructure that enables you to perform advanced research, including chemical, molecular and technological scope of research.

However, CRM systems evolve from systems implementing simple marketing functions to systems supporting the implementation of management processes related to the exchange of information between the organization and its customers. Therefore, such systems are particularly important for the STPs, whose philosophy focuses, for instance, on the initiation of contacts between business and science, dissemination of innovative solutions and building relationships with the business environment. Such a unit is defined as a Relationship Driven STP (STP which is based on relationships).

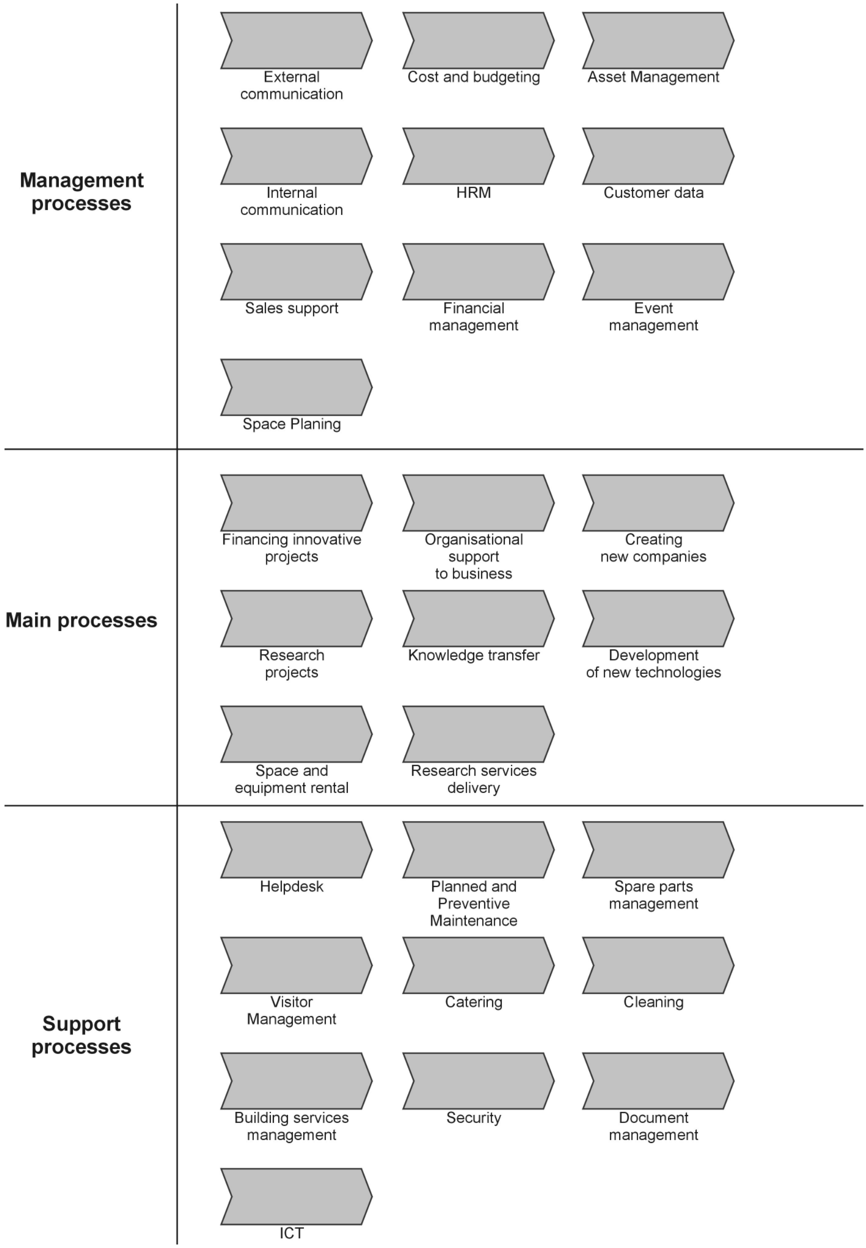


**Figure 22.4.** STP Process map

Source: Own elaboration, ADONIS CE BPM Toolkit

Example of the Relationship Driven STP is Krakow Technology Park, which is a part of the Krakow Special Economic Zone. It has facility area of 4100 $m^2$ and focuses on business support services. The most significant form of its operation is the provision of support to businesses at all stages of their development. There are other main activities like:

- KTP Seed Fund – includes the possibility of financing innovative projects.
- Business in Malopolska project – the idea to conduct the project originated from the intention to aid businesses in planning their investment in our region.
- KTP Technology Incubator provides a place for people considering starting their own business, operating in the ICT and/or engineering sector, and seeking an appropriate environment for their ideas and themselves.
- Clusters – Park has established a number of clustering initiatives: Malopolska Information Technologies Cluster, Krakow Design Zone and Digital Entertainment Cluster

The majority of STPs deal with a mixed model, namely the one that focuses on the use of infrastructure as well as the support of contacts and innovation encouragement. Therefore, the concept of the basic software supporting the activities of these units must take into account both the area of auxiliary processes and management processes, realizing as the strategic goal the concepts of both FM and CRM. Due to the increasing demands on the part of STPs and offer of information companies, corresponding to the needs, separation of the software market for R&D, including software for STPs, can be noticed.

Solutions such as Commercial Of The Shelf (COTS) have become available on the market [Shaw, 1996, p. 3–6]. They contain a set of best practices that can be implemented by organizations. This allows for a more dynamic development of the internal processes of the STP, especially at the early stage of the development. Nowadays, it is not possible to provide information support for a complex STP by one information system (Table 22.1). A solution based on CRM will neglect to some extent the aspect of infrastructure, whereas, in the case of FM systems communication with customers will be sidestepped. We propose that these two systems should be combined in one software category, the class – Area of Innovation Management Systems (AIMS). This approach could provide a systematic basis for a solid and informed discussion on STPs architecture to help their managers develop innovation flow in regions and industries.

**Table 22.1.** Example of key system features for Infrastructure and Relationship Driven STPs

| **Infrastructure Driven STP (CAFM – oriented)** | **Relationship Driven STP (CRM – oriented)** |
|---|---|
| Helpdesk | Customer Data |
| Planned and Preventive Maintenance | Contact Management |
| Asset Management | Marketing |
| Space Planning | Document Management |
| Spare Parts Management | Ticketing System |
| Work Orders | Sales Projects / Leads Support |
| Resource Management | Finance |
| Cost and Budgeting | Staff Management |
| Utility Management | Service/ Call-Centre Management |
| Visitor Management | |

Source: Own elaboration.

## Conclusion

The conduced analysis depicts that due to the nature of the management of the Scientific and Technical Parks, different approaches to the process of computerization of processes taking place in them are being observed. The units, where the process of infrastructure sharing dominates, are strongly orientated towards the auxiliary processes, especially related to the maintenance and management of infrastructure and laboratories. In the case of units pursuing their objectives mainly on the basis of establishing relationships and information exchange, those processes are less important; focusing instead on the processes related to, among others, communication with customers. Due to the fact that the information systems supporting the management of such park should generally include both of these areas, it is not often possible to offer a single solution (e.g. CAFM or CRM) to manage the park. The study also reveals that there is a low interest in the implementations of functionality related to the area of Facility Management. However, there is a high interest in the area of reporting and cost management. It may indicate that the opportunities posed by the implementation of systems to support the management of STPs, especially systems that are dedicated to this type of organizations (Area of Innovation Management Systems – AIMS).

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Chapter 23
# Rules for modelling and redesigning supply chains

*Wacław Szymanowski*

## Introduction

Logistics has added greatly to the European economy growth already. Despite being a relatively young knowledge area, logistics gains in significance together with efficient methods for supply chain modelling and redesign. The supply chain management is understood as processes carried out for designing and maintaining the reliability and operating activity undertaken in order to satisfy the end user [Ayers, 2001].

The basic supply chain management (SCM) rules are as follows [Christopher, 2000]:
1. The supply chain should be treated as an organization, entirety, and not as a group of separate subjects bearing responsibility for separate activity areas they operate within.
2. The SCM requires the strategic approach to the decision making.
3. The SCM requires an approach based on the integration of separate links thereof, and not only on the co-ordination thereo.
4. In the SCM area, product/material stocks only play an auxiliary instrument role in the chain link integration activities, and not the basic role.

## 23.1. The permanent supply chain improvement rule as the basis for modelling supply chains – application of the deming cycle

The supply chains modelling is applied for designing new supply chains and redesigning old ones. The supply chain redesign can be executed as a radical restructurisation, which was proposed 1993 by M. Hammer and J. Champy in the shape of the Business Process Reengineering (BPR) method, or as an evolutionary process reconstruction based on the incremental rules as proposed 1933 by T. Davenport.

The supply chain restructurisation process is based on the permanent improvement rule resulting from the Deming cycle: Plan – Do – Check – Act (PDCA). The Deming cycle consists of stages as follows [Deming, 1993]:

Stage 1 – "Plan" – set a goal for each process. Meeting the goals will provide with compliance of processes with customer requirements and with the general enterprise policy. In the context of making the supply chain more able, this means the determination of strategy for the entire chain, such strategy including: the vision, goals, mergers and fusions, product development plans, organization improvement plans.

Stage 2 – "Do" – processes should be implemented as planned. With regard to the supply chain improvement, this stage should include the development of an operating plan consisting of strategy components, i.e. initiatives, and activity proposals. As well, separate teams should be organized for: the strategy execution – Steering Committee (SC); processes – Supply Chain Design Teams (DT); activities – Front Line Teams (FLT). The teams carry out the tasks assigned to them in the three-stage implementation process. The implementation process includes:

1) project concept,
2) detailed project and pilot tests,
3) full implementation.

Work division: the Steering Committee (SC) is responsible for the 1st stage work (project concept); the Design Teams (DT) supervises the 2nd stage work, whereas the Front Line Teams (FLT) are representatives of supply chain users. The teams support the redesign of supply chains.

Stage 3 – "Check" – this stage consists of metering and monitoring significant parameters of processes and products. Then, the actual parameters are compared against the set parameters obtained from product-related strategies and goals as well as from product requirements. When the supply chain is reengineered, this means that changes are proposed, and the change implementation experiment is monitored.

Stage 4 – "Act" – is the undertaking of activities related to the permanent improvement of processes and their results. The change proposals should be evaluated in the context of supply chain redesign, and executed.

The project concept execution procedure for the supply chain improvement includes 5 stages: description of the supply chain current status, i.e. description of the chain supply major processes (As – Is); determination of strong items and weak items of the current supply chain status (As – Is); development of a new final vision of the supply chain; definition of required process statuses (To – Be); determination of gaps between the starting status and the required final status of the supply chain component processes, such determination being the basis for the formulation of the design concept and activity plan.

Within the Stage 1, a process map is made to be the basis for the identification of process structures. The process list includes: new product research and development; supplies, internal logistics; production planning and control; manufacture and product picking; sales; customer orders; external logistics; customer service and after-sales services support [Handfield, Nichols, 2002]. The mapping process executes numerous tasks:

– facilitates a better understanding of processes: activities, results, and structure of responsibility for individual stages,
– determines the process areas and limits,
– provides with methods for improving processes for future.

The following activities should be carried out in order to find out the current status of As-Is processes:

1. Processes defined and described in quality terms, using the relation mapping. Such work will facilitate obtaining answers to the questions: who is the process user; what is the process outcome; who are the suppliers; what is put into the process; what are the requirements for the input data and output data; what flows through the process.
2. Flow map produced to show all activities as a detailed map.

The process mapping provides with information with regard to [Ayers, 2001]:

1. Register of process activities and stages, and of people responsible for the execution thereof.
2. Definitions of characteristic parameters describing the processes, relating to the work time, leisure time, and costs.
3. Determination of process customers. Customer groups are divided in segments, with a division in external customers and internal customers.
4. Process results, depending on information collected from interviews and by different methods.

Stage 2 facilitates assessing weak points and strong points of the starting situation, and then making the SWOT analysis. The assessment of weak/strong points of the current chain processes facilitates a better assessment of the process usefulness. This assessment is made based on: quality meters, benchmarks, comparison of design rules, e.g. for supplies (As-Is), and facilitates determining how good the processes are and whether processes can be improved by application of: the best practice, the customer value-added evaluation, interviews-assessments obtained from customers or users, identification of narrow throats, application of quality house analysis, or SWOT assessment. The assessments allow specifying new processes and are collected by Design Teams (DT). The process specifications have attachments with assessments that allow determining the competitive edge of these processes as the starting pointy for the definition of a new vision in Stage 3.

Stage 3 consists in the development of a new vision target for the supply chain; this new vision should be dramatically different than the starting point. The Design Teams should use expert opinion while creating the new vision. The following changes should be carried out in order to create this vision:
1. Flow processes revised.
2. Organisation adapted to support these processes.
3. Changes made within the supply chain.
4. Infrastructure (equipment, assets) adjusted.
5. Meters developed for redesigned processes.
6. Costs decreased – receipts increased.
7. To-do-tasks specified.
8. Steps proposed for Stage 5 – detailed design, pilot program implementation.

Stage 4 consists in the definition of required process statuses (To-Be). This stage is executed by numerous meetings, in three sequences: presentation of numerous required process statuses that create the new vision for the supply chain; a number of sessions for preparing variants for the new vision; and, in the end, by the final decision on the final process (To-Be) as set in the required vision.

Stage 5 – consists in the preparation of detailed design with the target vision of the improved supply chain and of the pilot implementation, in three form of a detailed documentation. The proposed solutions undergo tests; the to-be-implemented solutions are accompanied by change proposals regarding the organization of new supply chains. Figure 23.1 shows the location of five groups of tasks selected to be carried out.

## 23.2. Tasks regarding the supply change reengineering

Within Stage 1, the Design Concept, or the *task no 1*, is carried out: Designing Supply Chains for Strategic Advantage, where segments are redefined – this is the area (domain) for the chain activity, new products development co-ordination and management.

Stage 2 – Detailed design and pilot solution tests – *task number 2* is carried out. – Implementing Collaborative Relationship. This task includes: organization structure changes for specified functions within the supply chain reorganization procedures; determination of activity evaluation meters, new positions for management functions in the supply chain organization.

Stage 3 consists in the execution of *tasks 3, 4, and 5.*

*Task 3* – Forging Supply Chain Partnerships includes: determination of competencies for chain links; forging partnership structures in the supply chain; forging motivation systems.

*Task 4* – Managing Supply Chain Information includes: determination of system components; selection of technological innovations and software solutions; determination of barriers.

*Task 5* – Removing Cost from the Supply Chain includes: cost removal sources; factors supporting cost removal; weak points of product design procedures; incorrect information in decision making; weaknesses of partnership rules within the supply chain (Figure 23.1).

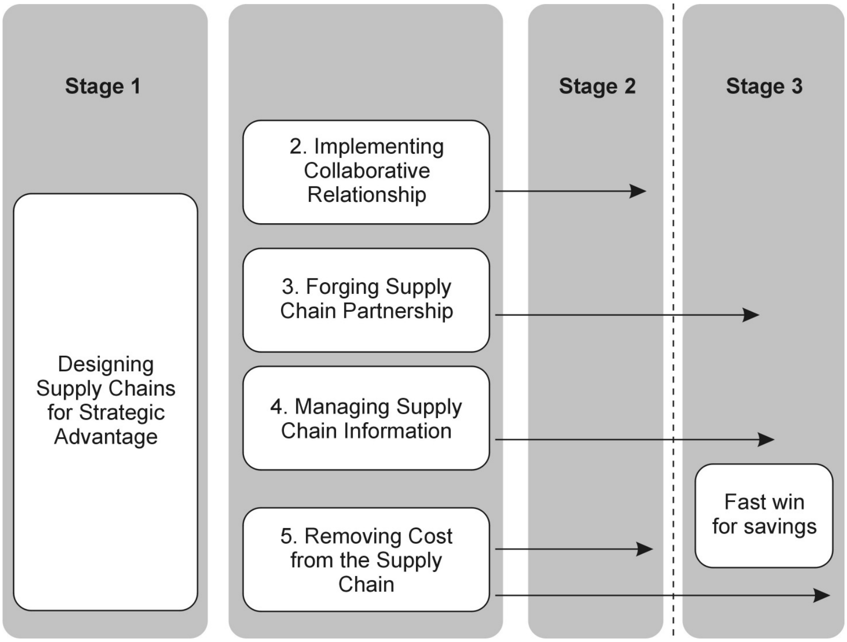


**Figure 23.1.** Supply chain design method

Source: [Ayers, 2001].

## 23.3. Selection evaluation criteria for variants of the redesigned supply chain

When working according to the permanent supply chain improvement method and while doing Task 5, the cost reduction is executed in three dimensions at the same time: cost, execution time, and quality achieved for the analysed supply chain processes. A multi-dimensional problem is created, which only can be solved using the M. Porter value-added analysis.

Unlike the efficiency analysis executed by T. Kasprzak in "Modele referencyjne w zarządzaniu procesami biznesu" ("Reference models in business process management"), the metering rule and evaluation analysis for logistic processes was based on three criteria: quality of the product, logistic services, and customer service; order execution time; logistics costs [Twaróg, 2003].

While creating the added value for customers, the achievement of an optimum between the level of services executed for the customer and the costs thereof is the major issue. The selection of logistics system variant should facilitate minimizing the total logistics costs for the execution of logistics services' level as assumed.

The VCA (Value Chain Analysis) method (approved by the ECR Europe Council) is commonly used for distribution processes. This method is defined as the integrated set of tools and processes for the determination of running costs and for the evaluation of proposed improvements' impact on the entire supply chain. This method facilitates the chain actors to evaluate financial effects of their own and of their partners. The VCA method applies various solutions, including standard solutions such as: the ABC (Activity Based Costing) method facilitating the supply chain actors to examine the cost structure over the entire value chain for individual product groups; logistic efficiency indicators (KPI-Key Performance Indicators) used for the benchmark-based determination of current potential in comparison to leaders; determination of non-financial targets. The non-financial targets include: promotion efficiency; supply reliability; stock rotation; order coverage; product program complexity. For the execution of strategic goals and for the supply chain efficiency evaluation, a set of logistic criteria was proposed as follows: improved production and sales planning; flow time minimization for materials and products in the network; stock reduction and optimization for all supply chain links; cost reduction to a customer-accepted level; improvement and assurance of high customer service level [Twaróg, 2003].

## Conclusion

The main goal of the paper is presentation of circumstances for supply chain modelling and redesign. The most efficient approach for modelling business processes is the Business Process Orientation developed 1993 by T. Davenport. This approach was adapted for planning processes using the W. Deming PDCA method. Then, the supply chains redesign principles as defined by J.B. Ayers are presented. The redesign process is divided in three stages: design concept, detailed design, and implementation. The goal of the last part of the paper is: forging the supply chain partnerships and mapping the supply chain information, as well as removing cost from the supply chain as part of the detailed design.

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Chapter 24
# Model of ICT knowledge transfer and its implementation in industry

*Jolanta Sala, Halina Tańska*

## Introduction

In 2012–2014 the authors participated in the project whose aim was to work out, test and implement a model of tools knowledge transfer[1]. The model is tools-knowledge oriented strictly connected with information-communication technologies. ICT tools offer is significantly wide, however in socio-economic practice it is necessary to define precisely the target group of participants (recipients and users) of the transfer model and a suitable selection of ICT tools. On one hand, model assumptions should be of a universal character and on the other hand, its usefulness qualities can be verified in practice after refining even smallest details. In the first implementation of the model this refinement was focused on engineering and technical workers of design-and-production enterprises and the selection of ICT tools on integrated computer aided systems CAD/CAM/CAE. The justification of the model implementation was published in [Sala, Tańska, 2013]. Subsequent implementations of the model of ICT knowledge transfer as a key tools competence of a modern human and low Polish rates in comparison with EU member states [Szymanek, 2014] are planned.

The goal of this paper is a synthetic presentation of universal theoretical assumptions of a model of ICT knowledge transfer and the results of its practical testing and implementation among engineering and technical workers of design-and-production enterprises in Pomorskie voivodeship in the range of CAD/CAM/CAE systems.

[1] The project was titled "The way to professional excellence" and received a minor subsidy in the framework of priority VIII POKL for working out a model and its verification (testing) on a small scale.

## 24.1. Theoretical assumptions of a model of ICT knowledge transfer

The fundamental assumption of a model of ICT knowledge transfer refers to its structure. The model consists of four components including three substantive components for recipients and one institutional component for users[2]. This simple structure is illustrated in Figure 24.1.

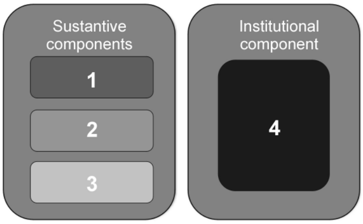


**Figure 24.1.** Components of a model of tools knowledge transfer
Source: Own elaboration.

The complex use of four components constitutes a methodology of bridging the competence tools gap of workers on three levels of education (1-university, 2-secondary, 3-lower secondary) working in a selected sector of socio-economic life. The methodology presented synthetically in Figure 24.2 is open and provides ways to reach flexibility and safety in a professional life. It provides a way of transfer and acquirement of ICT tools knowledge as well as skills to use it by working people so that they can adapt to new conditions and in case of possible changes in their professional careers. The institutional component (4) is the necessary and sufficient condition of the model realisation. Each substantive component (1, 2, 3 in Figure 24.1) consists of four following elements matching the needs of workers from each education level:

- a course, i.e. a programme (range of topics, number of hours, professional profiles);
- tools knowledge transfer kit on an electronic medium containing a course book, exercises, files, technology competence auto-diagnosis forms;
- consulting meetings (before, during and after the course depending on the needs of each participant) in a suitable location;
- one's own work at home or in a group work room using software available under periodically free license installed on a computer delivered for the time of knowledge transfer.

[2] According to the testing innovative projects terminology a worker is a recipient and an enterprise or another organization or institution interested in advising, educating or research and development activities is a user.

The following four elements constitute the institutional component (4 in Figure 24.1):

– a cluster for companies interested in knowledge transfer bridging the tools competence gap resulting from the lack of awareness and skills to use ICT tools at work;
– an association or foundation for employees and employers, entrepreneurs' and workers' organisations, business environment institutions, educational as well as research and development institutions;
– tools knowledge transfer kits on electronic media for adults with professional experience (minimum 2 years) on university, secondary and lower secondary levels;
– human resources identifying with the idea of tools knowledge transfer.

The realization methodology of the model of ICT knowledge transfer (Figure 24.2) contains two branches: (A) tools knowledge transfer, (B) partnership of knowledge transfer via strategic innovation.

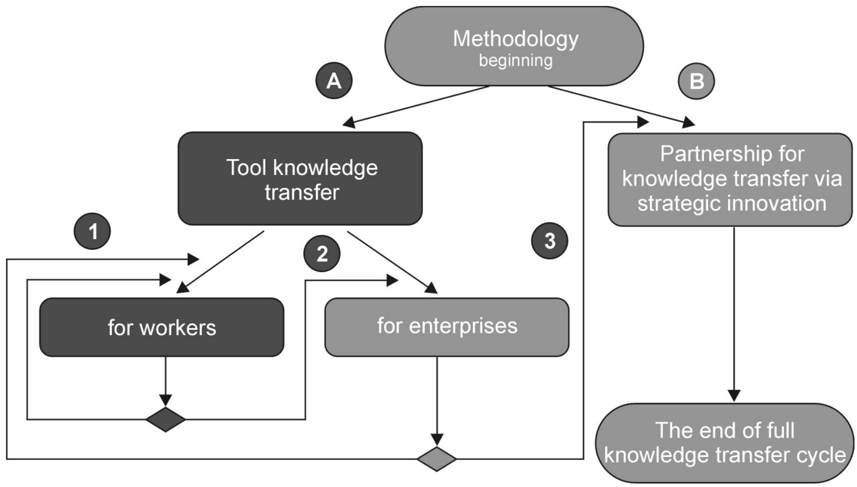


**Figure 24.2.** Methodology of the model of ICT knowledge transfer

Source: Own elaboration.

The branch A offers two ways of digital competence acquirement: for workers (A1), for enterprises (A2). The branch B is a British solution Knowledge Transfer Partnerships (KTP programme) and constitutes in establishing a partnership of three parties – representatives of an enterprise, representatives of science (R&D) and representatives of KTP (totally a team of 6–15 persons) so that they can work out and implement an innovation strategic for the enterprise. The A3 path combines both methodological branches and guarantees the science representatives and workers being enterprise representatives build together with the representatives of the institutional component of ICT knowledge transfer model the atmosphere of trust and co-operation as well as outline a strategic need of the enterprise.

The main assumption of the substantive components of the model is to improve digital competences of workers on all three levels of formal education (transfer direction: science – business) providing a common language of communication between levels (transfer direction: business – business) as the essence of path A1, and then with science representatives (transfer direction: business – science) in the context of the path A2.

The course is not of an instructive character but stimulates to creativity in a selected economy sector in the context of A3 path and strategic innovation for the enterprise (Figure 24.2). The key assumption of the course was subordinated to the expectations curve during the ICT technologies implementation (Figure 24.3), which means the course is to make recipients fascinated with selected ICT tools possibilities, then it has to lead the participants through the disappointment to the point "P", from which they will be able to improve their skills on their own (during their own work and consultations) and reach the full phase of using a given ICT technology.

Each edition of practical testing and implementation of the model of ICT knowledge transfer should be preceded by detailed diagnostic research of the employees' and employers' potential and needs in a selected sector of socio-economic life. Resulting from the diagnostic research and direct co-operation with the selected representatives of the target group a tools knowledge transfer kit strictly suited to the needs of enterprises and organisations from the selected sector is to be worked out.

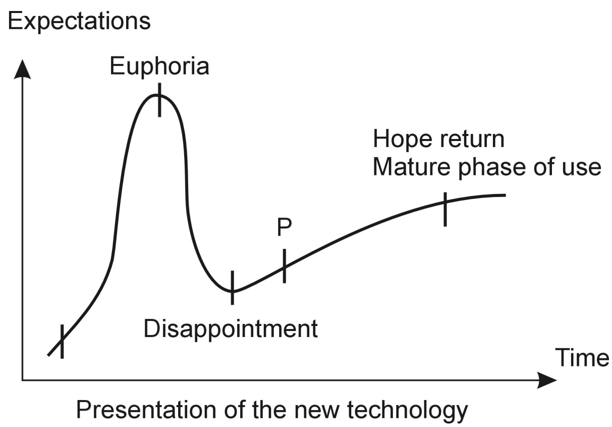


**Figure 24.3.** Expectations curve during the ICT technologies implementation

Source: Own research based on results of expectations research done by Garner's team.

## 24.2. Assumptions and results of the implementation of the ICT knowledge transfer model in industry

The first edition of the implementation of the ICT knowledge transfer model was dedicated to industry and verified in Pomorskie voivodeship[3]. In the result of the detailed diagnostic research of the potential and needs of workers employed on engineering and technical posts and of design-and-production enterprises in Pomorskie voivodeship [Report, 2012, p. 14–18] the hypotheses made have been confirmed, in particular the one which says that workers employed on engineering and technical posts have insufficient access to modern computer tools CAD/CAM/CAE supporting their work [Sala, Tańska, 2012].

Model assumptions of an institutional solution for knowledge and competence transfer have to consider a situation on the global market of ICT solutions. Recently the level of ICT development has stabilized and ICT in many cases have been reaching the mature state without turbulent changes. In years 2010 – 2012 an exceptional period for integrated computer CAD/CAM/CAE systems applications (dedicated to PLM i.e. management of a product life cycle) could be observed on the global market of software, which, however, were connected with financial conditions being too high for Polish enterprises. This is tools area which is strategic for design-and-production enterprises. The present price policy among the three main players on the software market offers great chances for the development guaranteeing enterprises a great technological leap accompanied by innovativeness and competitiveness increase [Sala, Tańska, 2012; Sala, Tańska, 2013].

Having known about such an advantageous situation additionally to the software market analysis a macroeconomic analysis of industry and labour market has been done. Its results confirmed research hypotheses of drastically bad situation and difficult to foresee socio-economic results in the case of its deterioration. The effort to organise a partnership[4] for practical realisation of the model of tools knowledge transfer was undertaken.

It was decided to include in the undertaking experienced and successful employees on engineering and technical posts with formal education on levels: engineering, technical and vocational. 10 science representatives (representing users) and 60 recipients, i.e. engineering and technical workers: 20 persons on high level of formal education (engineering), 20 persons on secondary (technicians) and 20

[3] Due to the possibility of financial support of the implementation of ICT knowledge transfer model.

[4] The co-operation was undertaken by several institutional partners from the science and practice sphere and in particular the Międzyzakładowa Organizacja NSZZ "Solidarność" of Gdańska Shipyard in co-operation with Technical University of Gdańsk undertook the formal responsibility.

persons on vocational level participated in the testing phase of the model. The course of the pilot implementation is illustrated in Figure 24.4.

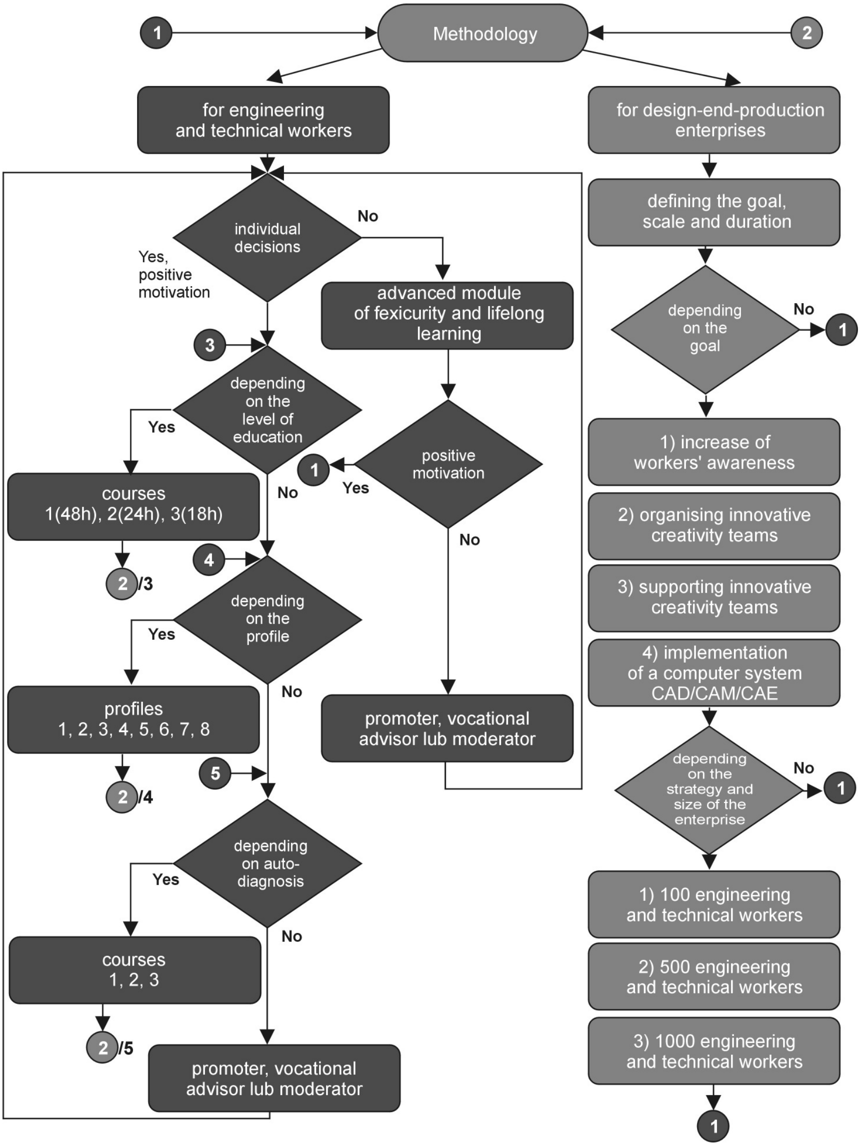


**Figure 24.4.** Decision and verification of the model of CAD/CAM/CAE knowledge transfer implementation in industry variants in years 2012–2014

Source: Own elaboration.

Figure 24.4 presents five decision knots on the A1 path (the left branch). The first two have a motivational character (identification of one's own professional successes and strengthening the will to undertake an effort to improve one's professional excellence supported by ICT). The third locates the course recipient depending on the declared formal education level, the next identifies the professional profile with better professional future, and the last increases the influence power of the previous steps by applying the auto-diagnosis of technological competence before and after the course (truth tests mobilising to self-continuation of reaching excellence and creativity).

The scale of this group in the voivodeship was estimated to a total number of 80 000 persons (respectively on each level: 30 000, 30 000, 20 000). The institutional solution was to meet this challenge in the period of 3–5 years since its implementation in 2014, i.e. to 2020. Two new subjects of advising, educational and research character were established. A network of subjects was established. They formed a cluster which after summarising the experiences was the basis for establishing a society – The Institute of Knowledge for Industry. In the initial phase of the society activities its substantive area is identical with the area of the Pomorski Technological Competence Cluster, as they will exist parallelly. In time the substantive and institutional areas of both organisational forms will evolve according to pragmatics of such solutions [Sala, Tańska, 2012].

The owners and management staff of Pomeranian production enterprises (finally 500) weakened by the situation of shipbuilding and its co-operative industry will find themselves in a new decision-making situation (staff, tools and strategy). However, it seems that only a big scale of the undertaking will be perceived in socio-economic life of the voivodeship [Sala, Tańska, 2012]. Thus in this case the state intervention in co-financing the continuity of tools knowledge transfer is necessary as neither employees nor employers are able to carry this burden on all methodological paths.

## Conclusion

The implementation of the model of tools knowledge transfer in the area of CAD/CAM/CAE for engineering and technical workers in industry has been verified and is open to further applications as the documentation of the model is available for free in an electronic form (6 manuals – two for each substantive component and two elaborations of institutional component).

A plan of further editions of the model of ICT knowledge transfer is being worked out. The assumptions of one of editions were presented in a paper [Sala, Tańska, 2014a] and they have an transnational character. The second edition is similarly universal basing on an authors' idea of an enterprise development via cultural adaptability and technological innovativeness, which was mentioned in the paper [Sala, Tańska, 2014b]. Both of these proposals are dedicated to the already verified target group, i.e. workers on engineering and technical posts and industrial enterprises constituting a wider path A2 (Figure 24.2). However, the implementation of the model of ICT knowledge transfer synthetically presented in Figure 24.4 is oriented mainly to the effectiveness of the path A1 (for employees), which means individual creativeness. Both new proposals guarantee a faster and more effective way to team creativity and innovativeness, however, their implementation will require greater effort from both the employees and the employers.

Among further and less polished plans of implementation of the model of ICT knowledge transfer is an adaptation of methodological solutions presented in the monograph [Kubiak, 2003]. The adaptation will blend the approach "from the bottom to the top" with the approach "from the top to the bottom" undertaking at the same time activities aiming at the innovativeness of enterprises deciding on the strategic revival in co-operation with the science and business circles. However, the necessary condition is the individual innovativeness of employees aiming at bridging the tools gap (path A1 of the model).

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Chapter 25

# An integrated approach to the transformation of the National Security System of the Republic of Poland

*Tomasz Protasowicki*

## Introduction

The role of the National Security System of the Republic of Poland (NSS of RP) includes ensuring the inviolable survival of the state and guaranteeing the security of its citizens. To meet this challenge, it is necessary to ensure the conditions for the effective operation of the NSS RP as an entity controlled through its mission and oriented towards efficient performance. To this end, independently managed systems and institutions need to be integrated in a manner ensuring the consistency of strategic goals, business processes, information flow and utilization of resources across the NSS RP.

Currently, the NSS RP works as a set of independent operating systems governed by a number of legal acts (The Constitution of the Republic of Poland, laws, regulations). The multiplicity of these acts combined with the lack of regulations ensuring their consistency makes the NSS RP legally and organizationally incoherent, full of gaps and overlapping scopes of competence. Hence, deep changes and transformation of the NSS RP is needed. As its final effect, a legally defined, organizationally, functionally and informationally consistent NSS RP will be developed, capable of executing the mission to protect and defend the state as apolitical institution and ensuring a continual and free from disturbances existence and development of the society.

The purpose of the research project was to draft a proposal of an integrated approach to the transformation of the NSS RP. With regard to the so-defined objective, the research procedure included in particular the following steps: the current state of the NSS of RP was defined, key aspects of the NSS RP transformation background were identified and analysed and an integrated approach to the transformation of the NSS RP was proposed. The present paper presents some of the author's findings resulting from the research project.

## 25.1. The National Security System of the Republic of Poland

According to the White Book of National Security of the Republic of Poland: "The National Security System of the Republic of Poland (NSS RP) is the entirety of forces (entities), means and resources earmarked by the state for the performance of tasks in the field of security, organized (into sub-systems and links), maintained and prepared in a manner adequate to the purpose of performing such tasks. It consists of a control subsystem (system) as well as a number of executive subsystems (systems), including operational subsystems (defence and protection) and support subsystems (societal and economic subsystems)" [BBN, 2013].

The current organization of RP's national security consists in the existence of separate operational systems, whose integration is very difficult due to their organizational and functional disjunction [Protasowicki, 2014]. Furthermore, almost each of these systems includes the same or nearly the same elements operating according to separate rules specified in the national legal regulations. If a situation exceeding the competence of individual, sector-specific services occurs, there is a need for efficient control over these services and their executive apparatuses to be provided through an adequately organized security system operating at various levels (commune – *gmina*, district – *powiat*, province – *województwo*, national), consisting of control bodies and an executive sphere, capable of efficient operation in peace, crisis and war [Kitler et al., 2013].

Considering the above, deep changes to the existing legal regulations are needed towards creating a network security structure, improving the effectiveness of operations, enhancing the cost-efficiency of solutions, as well as stimulating the quality-oriented development of the system. The existing studies on the NSS RP, its future shape and mode of operation indicate the need for adopting a holistic approach both when analysing its "as is" form and when designing and describing its "to be" model [Pawłowski et al., 2014]. It therefore seems justifiable to adopt an integrated approach to the transformation of entities performing tasks for the NSS RP, so as to be able to cover the organizational, informational and technical aspects of the process.

## 25.2. The NSS RP transformation background

### 25.2.1. The Digital Government vision

On the way of progressing evolution of the public administration apparatus, Poland is inescapably pursuing the vision of a Digital Government. It is perceived and it operates as one cohesive whole controlled by the mission and oriented towards delivering public value to citizens and enterprises alike [Sobczak, 2012].

The Digital Government is based on four fundamental ideas [Boni et al., 2012]:

– the boundaryless information flow,
– the citizen in the centre of attention,
– openness and participation,
– the right to privacy.

The concept of "Digital Government" is often identified with an efficient government. This means that various institutions of the public administration and the sector of public services operate based on the open government idea and offer services of the highest quality, in an efficient manner, using modern information technologies [Boni et al., 2012].

Currently, the whole informatization effort focuses on the implementation of the so-called Integrated Informatization paradigm, which is an attempt of a holistic approach to informatization and assumes the participation of all public institutions in the process of building, developing and maintaining the Government Information System, as well as implementing the process management standards in the public administration [Boni et al., 2012]. To perform these activities, public institutions need to understand the entirety of processes they are involved in and to be aware of their own role, as well as to take responsibility for the business functionality provided by them and the value delivered in this way. Integrated Informatization is based on four fundamental principles [Boni et al., 2012]:

1) the information flow must be logical and effective;
2) the information flow must be defined based on the informational needs of individuals and entities involved in business processes;
3) informatization must be transparent, effective and subordinated to achieving the best effort input-output proportion;
4) technological neutrality of the government must guarantee the freedom of choice as regards technologies to be used in the process of public services provision.

All activities pertinent to the NSS RP transformation (both in its organizational dimension and regarding information and communication technology systems) have to address the fundamental principles of the Digital Government and Integrated Informatization presented in this chapter. This will allow the activities taken in this area to be consistent with other transformational undertakings in respect of the government institutions and bodies, public administration units and other systems operating in Poland.

### 25.2.2. Systemic interoperability of the NSS RP

The interoperability issues in the field of public administration, as well as in the field of state defence and security belong to the main challenges of the NSS RP transformation now. On the one hand, this is an element of the Digital Government concept development in Poland and on the other hand, the problem should be considered in the context of the pace and the scope of national transformation towards the requirement of network-centricity and interoperability with NATO and EU imposed on Poland. This refers to interoperability with NATO and/or EU as supranational institutions in the broadly defined area of administration, as well as to joint activities taken within the frames of these organizations (e.g. in the field of crisis/emergency management and response, public health protection, defence, etc.).

The concept of interoperability was subject to dynamic evolution over the years and its perception has been changing and covering an increasingly wide range of issues [Protasowicki, 2013]. Considering the abundance and diversity of definitions of interoperability existing today, the definition proposed here is embedded in the context of the national security system (NSS) of the state. Hence, "in the context of the NSS, interoperability should be understood as all instances of communication between entities performing their specific roles within the NSS of the state, where exchange of information occurs between these entities (via information technology and ICT systems, among others) on their way towards the achievement of their objectives by means of the efficient and effective co-operation at the legal, organizational, semantic and technical level" [Protasowicki, 2013]. The instances of communication referred to in the definition quoted above are not limited to the internal communication within the NSS, but they also include the co-operation of the NSS entities with external partners referred to in the initial paragraphs of this chapter. Both the internal interoperability of individual elements of the NSS RP and the external interoperability of the NSS RP as an entity participating in supranational activities must be looked at as its immanent, systemic feature.

Hence, it must be addressed and embedded in the new model of NSS RP being designed now within the frames of activities aimed at system transformation. Furthermore, interoperability must be addressed at many levels and has to encompass the political context, as well as legal, organizational, semantic and technical aspects (Figure 25.1).

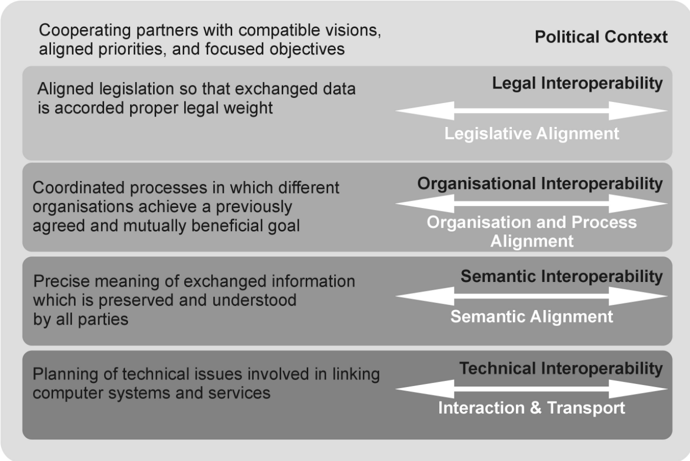


**Figure 25.1.** Levels of interoperability according to EIF
Source: [European Commission, 2010].

### 25.2.3. Basic assumptions and main objectives of the transformation of the NSS RP

There are many definitions of transformation today, differing depending on the context of organizational changes, as well as their causes, depth, pace, scale, nature, etc. [Sobczak, 2013]. For the purpose of further considerations here, the transformation of the NSS RP shall be interpreted as a set of legislative, organizational and information technology related activities aimed at the transformation of the NSS RP in a period between two points in time. The purpose of these activities is to achieve a significant change in the structure of this system and in its organizational culture, allowing for the growth of its capacity of effective operation. To this end, it is necessary to improve the collaboration between individual subsystems of the NSS RP, as well as to reinforce the accountability of the State authorities and other entities for the results they achieve in the area of Poland's national security.

The main characteristic of trends in development of national security systems of the EU and NATO member states is a multiphase process of transformation aimed at developing an environment oriented towards the achievement of network-centric capabilities. This is a multifaceted process, with business aspects and management aspects alike.

From the NSS RP point of view, the essence of network-centricity lies in increasing the capabilities of its constituent entities to capture, process and distribute information within the required timeframes, as well as in maximization of the extent to which information is used in their decision-making processes, as shown below (Figure 25.2).

The nature of the NSS RP operation is (and will be) based on arranging the collaboration of many sovereign actors playing their specific roles within the system, pertinent to system's principal functions resulting from legislative solutions. The collaboration of these actors aimed at achieving the results expected of them requires an intense exchange of information. It has to be organized in manner that will guarantee the synergy enhancing the efficiency of processes occurring within the NSS RP. For many reasons, this collaboration is characterized (and will be characterized) by the absence of any permanent reporting hierarchy, which may be a great challenge in terms of interoperability and may be looked at from the legislative, organizational, technical and cultural point of view. Bringing the independently managed systems constituting the NSS RP together in a manner allowing for synergy to be achieved requires openness to changes. For example, the habits and routines existing in the organizational culture of each individual entity need to be modified and/or given up. An ideal environment oriented towards network-centric capabilities has to enable the information sharing and the collaboration of many entities within the NSS RP in business processes crossing the vertical structures of discipline-specific systems pertinent to national security. Hence, it represents a federated space between all entities constituting the NSS RP, which encompasses also all their information and communication technology support systems.

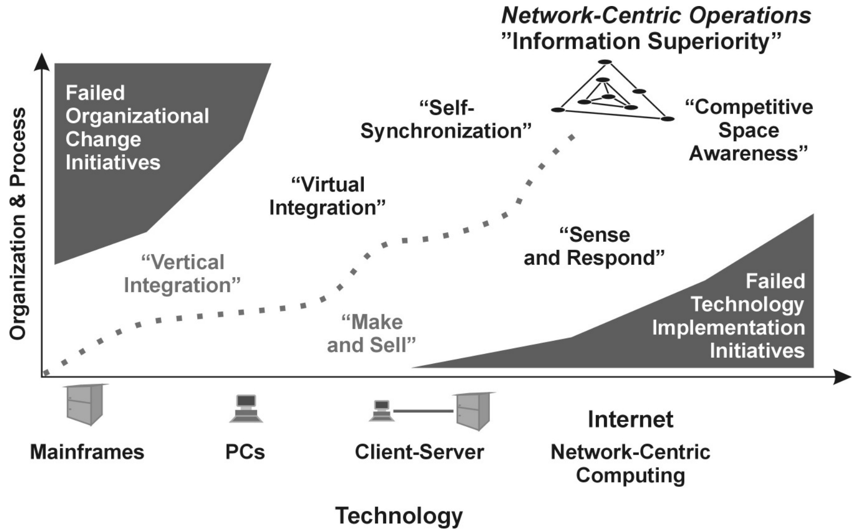


**Figure 25.2.** Evolution of organizations and technologies towards network-centric capabilities

Source: [European Commission, 2010].

### 25.2.4. Challenges of the NSS RP transformation

Before the process of transformation can be started, the main barriers identified within the existing design of the NSS RP need to be eliminated. The most important of them include:

- the internal incoherence of the existing NSS RP;
- no real commitment of the key stakeholders to the implementation of changes required within the NSS RP;
- no comprehensive vision of using IT solutions to support the NSS RP processes;
- no real owner of the NSS RP organization projects and lack of IT support at the highest decision-making level of the government;
- individual units' silent reluctance to collaborate in the field of information exchange and sharing;
- no operational mechanisms for co-ordinating, supervising and providing the ICT support to the NSS RP organization projects;
- limited possibilities of monitoring the tasks performed by the entities performing their tasks within the NSS RP;
- legislative, cultural, organizational, informational, technical and economic constraints regarding interoperability;

The broadly defined transformation activities related to ensuring the proper operation of the NSS RP need to involve the process of planning the use of ICT solutions. Therefore, when developing the methodology of the NSS RP transformation, not only organizational aspects must be taken into account, but also the problems of ensuring the ICT support to processes. Hence, the methodology has to represent an integrated approach. Furthermore, one should bear in mind that it is necessary to specify an objective and to pre-define performance indicators for measuring the progress of the NSS RP transformation. When planning this process, one should also take the existing capacity of organizations participating in the NSS RP into account, including their readiness to change, as well as to include the ICT solutions already supporting the system. Finally, the process of transformation should be organized in such a manner, that the program of changes does not disrupt the continuity of the NSS RP operation.

## 25.3. An integrated approach to the transformation of the NSS RP

The studies of the NSS RP have revealed the need for adopting a holistic approach, so as to develop and describe its "to be" shape [Pawłowski et al., 2014].

This will prevent the development of suboptimal solutions, i.e. the solutions that are effective in some of the organizations only, while not supporting the objectives of the entire NSS RP. In response to this need, enterprise architecture should be used as a basis of an integrated approach to its transformation and integrated with service oriented architecture.

### 25.3.1. A foundation of the integrated approach to the NSS RP transformation

Enterprise architecture is a formal description of the corporate components structure and functions (including people, processes, information and technology), the interrelations between these components, as well as the principles and guidelines in respect of the management of these components designing and changes over time. The enterprise architecture of the NSS RP is both a management program and a documenting method. Together, they will introduce a practicable, coordinated view of the strategic goals, the business processes, the information flow and the use of resources (including in particular IT resources) within the NSS RP. The enterprise architecture concept to be used in the transformation of the NSS RP has the advantage of being comprehensive both vertically and horizontally (Figure 25.3).

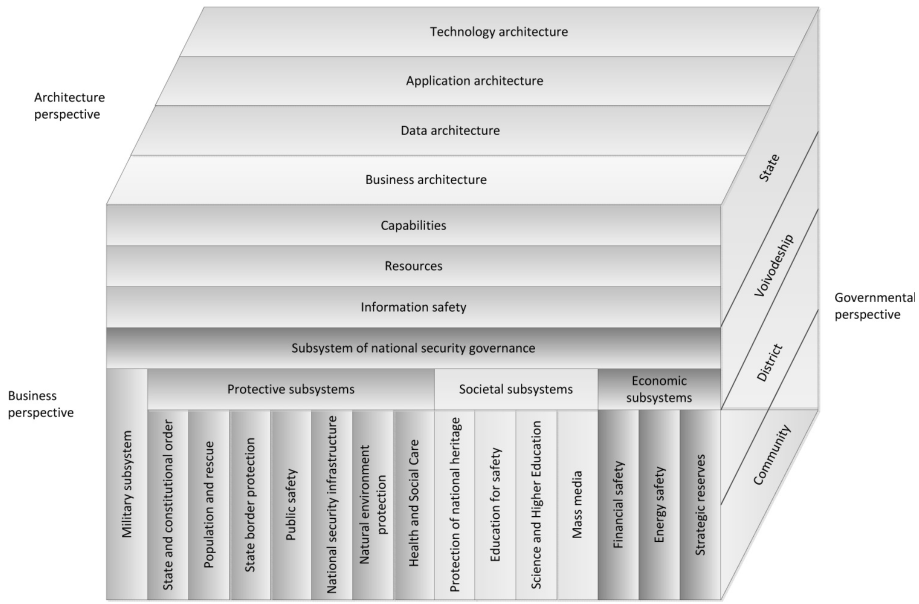


**Figure 25.3.** The NSS RP enterprise architecture cube

Source: Own elaboration.

Owing to the vertical arrangement, the organization of the NSS RP can be encompassed from the business area up to the technical area and consequently, the cause and effect relationship between the business, data, application and technical domain can be maintained. In particular this manifests itself in the open indication of the scope of the ICT support to business processes within the NSS RP. The horizontal approach allows for consistency of individual business areas and/or ICT solutions, due to coherent presentation of components together with their interrelations defined in the form of interfaces or mutual services.

The construction of the NSS RP enterprise architecture is a complex project integrating various activities in the field of organization, management, national security, law, information technology etc. Owing to this integration, it is possible to achieve synergy, resulting from, inter alia [Sobczak, 2008]:
– the harmonization of strategy, business processes and ITC support systems in the NSS RP constituent organizations;
– the optimization of resource allocation;
– the improved decision-making in respect of development of ICT systems and their compatibility across the NSS RP constituent organizations;
– the enhanced interoperability and efficient circulation of information between different entities performing their tasks within the NSS RP;
– the multiple use of the ITC system components;
– eliminating locally acceptable solutions and replacing them with globally optimal solutions;
– the effective coordination of long-term activities related to modification and development of the ICT support systems.

The development of the NSS RP enterprise architecture requires, inter alia, using an architecture framework. It is a basis allowing for the effective transformation of the NSS RP constituent organizations based on the enterprise architecture concept. Many architecture frameworks have already been developed in the world. Universal in their nature and built of components, they require adaptation to the needs of a specific organization. Owing to this property, the existing architecture frameworks can be used for designing a dedicated framework for the NSS RP project. The experience presented in the literature shows that it is not worthwhile to design an enterprise architecture methodology from the scratch – one should rather take the existing solutions and modify them as needed. So far, such attempts have taken place for example under the e-PUAP (Wrota Polski – an electronic platform for the public administration services) and the e-Podatki (e-Tax) projects in Poland. The approach used there was based on taking the TOGAF® architecture framework as a basis for designing an enterprise architecture and for the process of transformation.

Owing to the component-based structure of architecture frameworks, the existing global experience can be used for developing a dedicated methodology tailored to the process of the NSS RP transformation. For example, best elements delivered by various architecture frameworks and other methodologies (managerial, production, deployment, etc.) can be selected and adapted to the specific environment of the NSS RP. This should be a background for further activities towards using the renowned universal frameworks (e.g. TOGAF) as a basis for developing the NSS RP transformation methodology and integrating them with selected elements derived from frameworks designed to support the public sector (FEAF/FEA, CEAF, xGEA), the military sector (e.g. NAF, DoDAF, MoDAF) and discipline-specific frameworks for enterprise security architecture (e.g. SABSA). With an approach like this, the resultant enterprise architecture framework will match the nature of NSS RP, with its combination of civilian and military aspects.

### 25.3.2. The architectural potential of the Polish State

It should be noted that even the best methodology of the NSS RP transformation will be of no use, if an adequate potential of the Polish state required for effective execution of this process is not built. This potential has to be developed in the following capability areas:

- the supervision of transformation,
- the development of transformation strategy,
- the implementation of the portfolio programs and the resultant projects,
- the development and maintenance of the potential proper,
- the monitoring of benefits and taking corrective actions.

As a result of transformation, the NSS RP will gain the capability of performing certain activities in a new way, as well as of performing new activities that have been impossible so far. The key elements to be designed under the NSS RP transformation project should include integrated business processes, a comprehensive National Security Information System compatible with the Government Information System being developed and an integrated network-centric system of ICT support. In addition, the integrated approach to the transformation of the NSS RP presented here will significantly facilitate the progress in the field of its ICT support systems and the transition from the existing chaos to the state of order. The figure below illustrates the integrated approach to the NSS RP transformation (Figure 25.4).

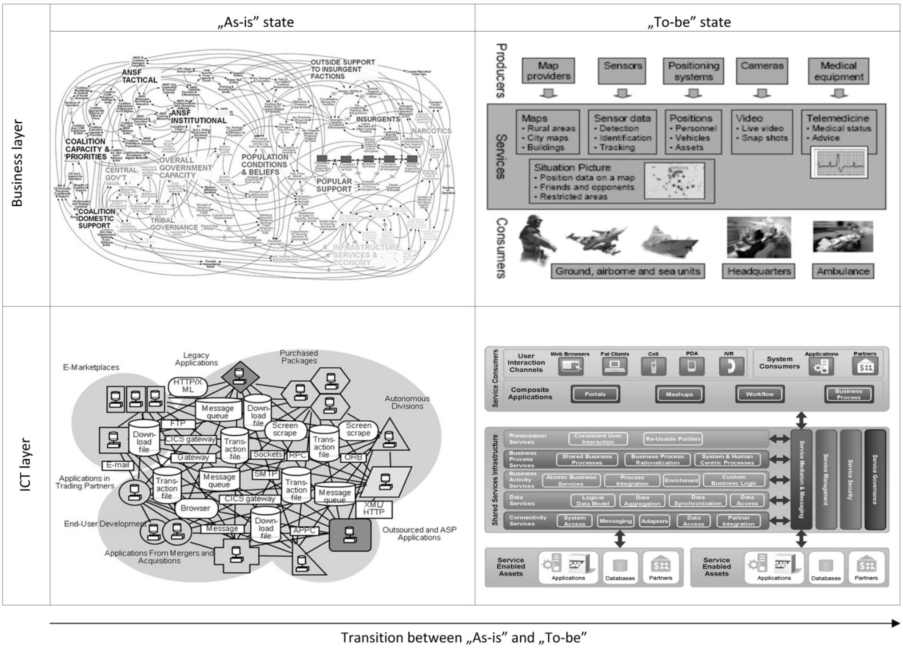


**Figure 25.4.** Integrated approach to the transformation of the NSS RP
Source: Own elaboration.

## 25.3.3. Principles of the NSS RP enterprise architecture

The enterprise architecture principles is a set of fundamental, permanent rules based on the organization's development strategy and representing its overall needs regarding the development of information systems. They provide a basis for determining the "to be" model of the NSS RP architecture (for business, data, applications and technical layer). The principles make it possible to establish and maintain a consistent direction of the NSS RP development in both the business and the technological area. To this end however, the principles have to be used in a consistent manner in all entities across the NSS RP, at all levels of the system.

The BSS RP enterprise architecture principles have to comply with the applicable laws and need to allow for the main requirements to be communicated effectively to different stakeholder groups. Therefore, they cannot be too specific, but on the other hand they have to take the form of recommended actions – unambiguous, complete, comprehensible, coherent and stable. The principles specified for the NSS RP are summarised below (Table 25.1). They provide a basis for specifying further principles to be created within enterprise architectures of individual sub-systems of the NSS RP and on the level of their constituent entities.

**Table 25.1.** Principles of the NSS RP enterprise architecture

| | Name | Description |
|---|---|---|
| Business principles | Coherent entity, one goal | NSS RP is a single, unified organization, concentrated on providing the broadly defined security of the state and the citizens |
| | Mission-driven enterprise architecture | The NSS RP's mission determines its enterprise architecture |
| | Enterprise architecture facilitates management | NSS RP's enterprise architecture facilitates the management of activities performed by its constituent entities. |
| | Maximized benefits and minimized cost and risk | Strategic decisions concerning legal, organizational and technical solutions regarding the NSS RP are always aimed at maximizing the benefits generated by them and minimizing their risks and cost in the long term. |
| | Operational continuity assurance in various states of the State operation | The continuity of the NSS RP operations is maintained regardless the changing states of the State operation, while the NSS RP enterprise architecture reflects the changes to its structure and the needs related to the change of these states. |
| | Compliance with the law, standards and policies | The entire scope of the NSS RP complies with the applicable regulations and standards and ensures the implementation of strategies and policies pertinent to the broadly defined sphere of security and digital modernization of the State. |
| | Systemic interoperability of goals | Interoperability of the NSS RP is its immanent, systemic feature. |
| | Matching the ICT support to the needs | The ICT systems supporting the NSS RP match the business and functional needs aligned with the priorities set at the strategic level. |
| | Service orientation | The NSS RP architecture is based on the process of designing services that reflect the activities of individual entities constituting the system in the real world and follow from the business processes performed by them. |
| Data principles | Information is a resource | Information is a critical resource of the NSS RP and, being a high value resource, is controlled and protected accordingly. |
| | Information sharing | Individual organizations constituting the NSS RP and their employees are authorized to access the information they need to perform their tasks. Therefore, information is shared by different subsystems and organizations, as well as roles, depending on the security levels specified for the given set of information. |
| | Accessibility of information in all states of the State operation. | Information necessary to perform the tasks within the frames of the NSS RP is accessible to all authorized entities in all states of the State operation. |

| | Name | Description |
|---|---|---|
| | Protecting information against unauthorized access | Information exchanged within the NSS RP is protected against unauthorized access and disclosure. In addition to traditional aspects related to the classified information protection, the information security measures include the multi-level protection of information used in decision-making and operating processes. |
| | Semantic integration | The meaning of information exchanged within the NSS RP is precisely defined and comprehensible to all its recipients. |
| ICT support systems principles | Technological independence | The systems of ICT support to the NSS RP are independent of the specific technological choices and are operational on various technological platforms. |
| | Ease of use | The systems of ICT support to the NSS RP are simple to use and generate positive user experience. |
| | Simplicity and reusability of solution components | The systems of ICT support to the NSS RP are built of simple components constituting a coherent entity with a clear architecture. |
| | Flexible solutions capable of adaptation to changing circumstances | The systems of ICT support to the NSS RP are flexible, scalable and ensure the possibility of performing specific tasks under circumstances related to the changing modes of State operation. |
| Technological principles | Requirement-based technological changes | Technological changes to the NSS RP are implemented solely in response to business needs and are introduced in due time. |
| | Controlled technological diversity | The technological diversity of the solutions operated within the NSS RP is strictly controlled in order to minimize the cost of maintaining the knowledge pertinent to various technologies employed in many dispersed processing environments and to maximize the benefits following from the ease of their maintenance. |

Source: Own elaboration.

### 25.3.4. Service orientation

Adopting a Service Oriented Architecture integrated with an Enterprise Architecture for the NSS RP transformation project will enable thinking about the business layer as well as the ICT support layer in terms of services, their development and deliverables allowing the processes to be executed within NSS RP. The combination of these two solutions is natural, since they both are oriented towards the integration of an organization and matching ICT solutions to the requirements. It should be stressed at the same time, that SOA is a multidimensional architectural approach and a technology-independent one. A well designed, controlled and managed SOA environment will allow services to be created, combined and implemented within the NSS RP quickly, thereby enabling one to respond to the rapidly changing needs resulting from the NSS RP development, as well as from the opportunities, challenges and threats in the field of national security of Poland. Furthermore, with SOA it is possible to create foundations for a secure and dispersed data processing environment for NSS RP, based on cloud computing. It may be provided according to the "Infrastructure as a Service" model (IaaS) for example and combined with the "Software as a Service" (SaaS) model of ICT solutions provision. It is also indispensable to address the necessity of analysing and choosing suitable upgrading strategies for legacy systems, as well as of adapting them to the SOA environment, if need be. In the data processing environment defined in this way, the matters related to the application of integration platforms for the purpose of the ICT systems integration are gaining significance. The degree of their complexity involves the need to solve many problems related to the maintenance and on-going control of their functional security. The entire model of service orientation in the NSS RP is illustrated below (Figure 25.5).

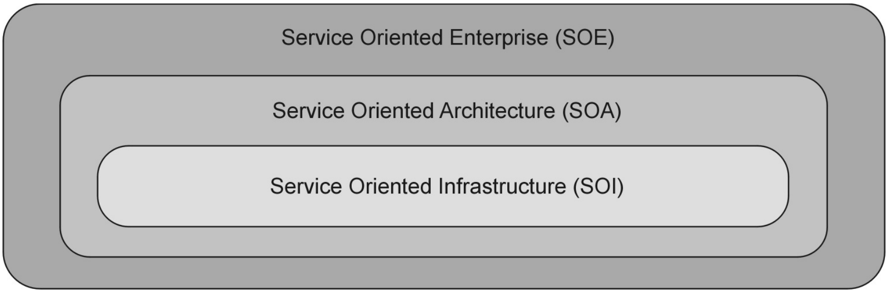


**Figure 25.5.** NSS RP service orientation model

Source: Own elaboration.

## Conclusion

The purpose of the research project was to draft a proposal of an integrated approach to the transformation of the NSS RP. In the light of the discussion presented here it seems necessary to adopt an appropriate approach to the transformation of the entities performing tasks within the NSS RP. It needs to allow this process to be performed effectively in the organizational, informational and technical aspects. As its final effect, a legally defined, organizationally, functionally and informationally consistent NSS RP will be developed, capable of executing the mission to protect and defend the state as apolitical institution and ensuring a continual and free from disturbances existence and development of the society.

The transformation of the NSS RP may be regarded as a revolutionary organizational change. As a result, it will be possible to achieve the network-centric capability through the information sharing across the network of organizations participating in business processes performed within the frames of the NSS RP. This will contribute to the enhanced effectiveness, efficiency and performance of the NSS RP, as well as to the reduction of its costs. The existing studies of the NSS RP and its "to be" model have revealed the need for adopting a holistic approach to the analysis of its current forms, as well as to describe the "to be" model [Pawłowski et al.]. This will allow the development of suboptimal solutions to be eliminated. To this end, it is necessary to design an appropriate methodology of the NSS RP transformation, which will comprehensively address the problems of assuring the interoperability of solutions and will ensure their compatibility with the uniform State Information System. The enterprise architecture concept is, in the author's opinion, an eligible candidate to become the basis of this methodology, while its characteristics make it an adequate tool for implementing the process of a revolutionary change in a system as complex as the NSS RP. At the same time, it needs to be integrated with the Service Oriented Approach. In addition, further research towards complete conceptualization of the NSS RP transformation methodology is needed.

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Chapter 26
# System architecture for the classified document lifecycle management

*Jarosław Napiórkowski, Robert Waszkowski*

## Introduction

The recent rapid growth of RFID technologies has yielded solutions allowing for effective reading of a significant number of radio-frequency identification tags arranged one on another. This opens a wide range of opportunities as far as the use of this technology for protecting and tracking classified documents is concerned. Using RFID labels and biometric methods allows for identification of individuals authorized to access specific documents. As a result, a state-of-the-art secret registry can be designed and implemented, so as to control documents representing multiple sensitivity levels. With registry processes adequately designed and RFID transmitter-receiver devices used, an effective information security control solution can be developed [Kawa, Wieczerzycki, 2005; Drucker, 1998; Michałowska, 2012].

RFID solutions are planned not only for documents and data storage devices, but also for the office equipment (cabinets, shelves, desks, copying equipment and entrance/exit control equipment). The integration of all elements in one system managed by means of dedicated IT solutions will enhance the safety and control of information with different classification clauses.

The present study presents an architecture of such a solution and describes technologies to be used for the integration of system elements. The models presented here were designed under the project financed by the National Centre for Research and Development Electronic system of managing the life cycle of documents with multiple sensitivity levels.

## 26.1. System architecture for the classified document lifecycle management system

Figure 26.1 depicts the architecture designed for the classified document lifecycle management system. The diagrams define the system boundaries and the scope of data to be exchanged with external systems.

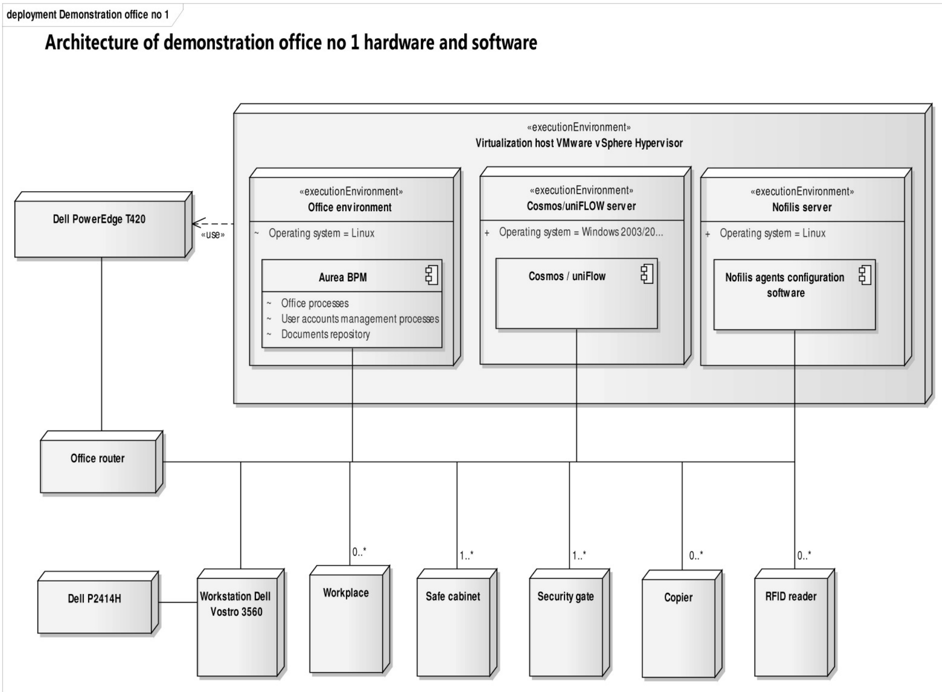


**Figure 26.1.** Architecture of the classified document lifecycle management system

Source: Own elaboration.

The logic architecture diagram (Figure 26.2) presents external interfaces of the document lifecycle management system. The system co-operates with external systems: CrossTalkAppCenter and Cosmos. Integration occurs via adequate programming interfaces (Web service). The document flow management system has also a graphic user interface (GUI) accessible from the Internet browser level. CrossTalkAppCenter and Cosmos also have user interfaces enabling the control and configuration of these systems.

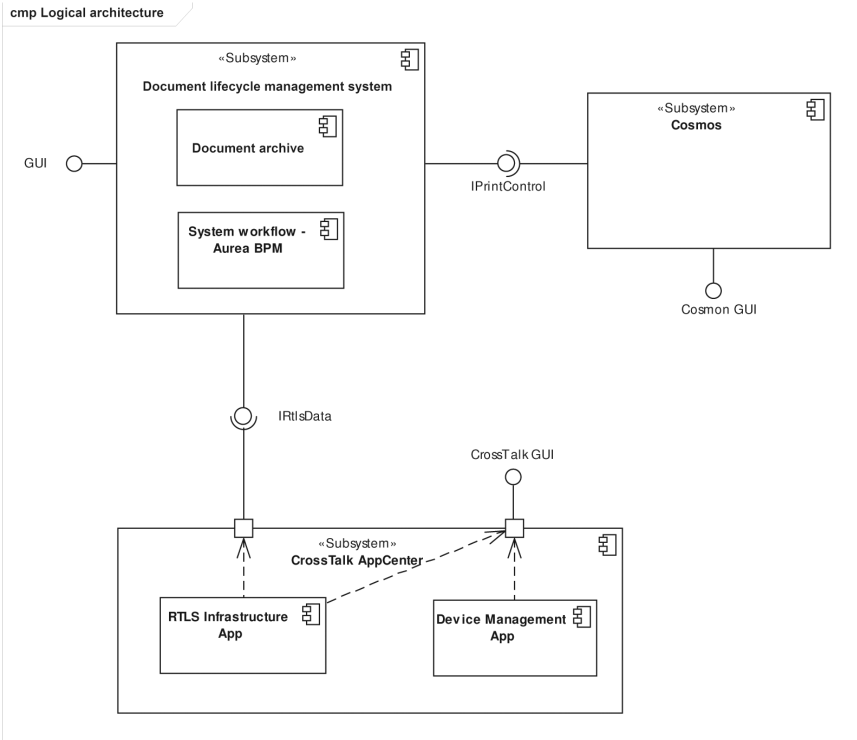


**Figure 26.2.** Logical architecture of the classified document lifecycle management system
Source: Own elaboration.

The classified document lifecycle management system consists of the following modules and components (Table 26.1):

**Table 26.1.** A description of the logic architecture components

| Element | Type | Description |
|---|---|---|
| System workflow – Aurea BPM | System module | A system workflow enabling the registry (office) business process management and automation. |
| Document archive | System module | A system module responsible for document control (paper and electronic documents), including in particular:<br>• searching documents,<br>• cataloguing documents,<br>• archiving documents,<br>• organizing documents,<br>• disposing of documents,<br>• providing access to documents. |
| CrossTalkAppCenter | System | A system responsible for tracking RFID-tagged objects. |

| Element | Type | Description |
|---|---|---|
| RTLS InfrastructureApp | System component | A component linking physical RFID/RTLS equipment to an application responsible for the business logic.<br>The component captures localization events from RFID/RTLS devices and sends RFID tagged objects localization information (events) to other systems. |
| Device Management App | System component | An administration tool for configuring the infrastructure of physical RFID/RTLS devices, configuring messages exchanged between them and monitoring their operation. |
| Cosmos | System | A system for managing the document printing and copying process in the registry (office) printing and copying equipment. |
| IRtlsData | Interface | A Web service interface responsible for handling the RTLS (Real-timelocating system) events generated by the CrossTalkAppCenter system based on the information from the equipment tracking RFID-tagged objects.<br>The interface is responsible for the integration of the document lifecycle management system with the CrossTalkAppCenter system in respect of handling RTLS (Real-timelocating system) events generated by the CrossTalkAppCenter system based on the information from the equipment tracking RFID-tagged objects.<br>Via the interface, RTLS events will be sent, including:<br>• Zone EnterEvent<br>• Zone LeaveEvent<br>• LocalizationEvent<br>• AreaEnterEvent<br>• AreaLeaveEvent<br>• Zone Read Event |
| IPrintControl | Interface | A Web service interface responsible for managing the document printing and copying process in the registry (office) multifunction peripherals, including:<br>• verifying user access to print or copy documents,<br>• registering document printing or copying events,<br>• registering and recording document scans (PDF files) in the document lifecycle management system's data base. |
| GUI | Interface | A graphic user interface of the management system for documents representing multiple sensitivity levels, accessible from the Internet browser level |

| Element | Type | Description |
|---|---|---|
| CrossTalk GUI | Interface | A graphic user interface enabling the configuration and administration of the RFID/RTLS physical infrastructure. The interface enables also the monitoring and visualization of RFID-tagged object tracking. |
| Cosmon GUI | Interface | A graphic user interface enabling the configuration of the workflow process for the management of document printing and copying in multifunction peripherals. |

Source: Own elaboration.

The basic functionalities of the electronic document flow management system include:

1) remote identification of unclassified and classified data storage devices labelled for real-time radio-reading at the point of storage and work;
2) automatic inventorying of unclassified and classified documents arranged in piles and filed, including automatic detection of relocation;
3) control of the movement of data storage devices, as well as unclassified and classified documents across security zones including the unclassified and classified document access control;
4) protection of data storage devices and documents against unauthorized relocation;
5) automatic identification of data storage devices and documents not only at the point of storage, but also at workstations;
6) protection against repeated copying of an unclassified and classified document;
7) control of printing unclassified and classified documents with a copy limit;
8) identifying the location of an individual unclassified and classified document with a pre-set accuracy of a file or volume location.

The document lifecycle management system will be mainly used by the personnel of the secret registry where the system is going to be implemented. Apart from the regular employees of the registry, the system will also be used by the administrator responsible for system configuration and administration. The system administrator may be the registry employee at the same time. The system will co-operate with external systems: CrossTalkAppCenter and Cosmos.

## 26.2. Data exchange standards

Following an analysis and a review of documents of the existing data transfer standards, such as Web Service, ODBC, JDBC, iDOC, ALE, a decision was made to choose Web Service, which uses the REST-compliant http access protocol [http://rfid-lab.pl, 2015; Orłowski, 2008; Sweeney II, 2005].

REST – Representational State Transfer – is a standard enforcing good practices of designing dispersed architectures. RESTful Webservices (or RESTful web API) is a Web service implemented using the HTTP protocol and the main principles of REST.

The REST architecture was chosen as the API standard with regard to the common availability of implementation and the facility of use. REST-based services are intuitive in use and self-descriptive, thereby saving the time needed for the maintenance and use of API documents.

The HTTP protocol used by the REST architecture allows for simple integration with other systems, regardless the technology they are based on. Furthermore, the protocol offers known and safe authentication methods based on simple authentication data (such as a login and a password), as well as on a more sophisticated, certificate-based authentication. Moreover, a safe HTTPS connection can be established using the SSL protocol.

The advantage of REST over standard web services based on SOAP lies in the easiness of implementation (which involves a shorter time of application generation) and the simplicity of integration with other systems. HTTP is natively supported by many applications (including also web browsers), therefore there is often no need for using specialist tools when testing REST-based services.

ODBC and JDBC are internal communication standards and are not recommended for an external API. Additionally, they provide a direct data base access, bypassing the security controls in the business logic layer generated as a Java application. Using ODBC and JDBC as an API standard would involve the necessity of duplicating security controls at the data base level. In this case, REST allows for using a single mechanism in the business layer.

iDOC and ALE are niche solutions based on tools offered by a few companies associated with them. Wishing to ensure an easy integration with external systems, we have chosen the commonly accessible and increasingly popular REST standard.

Other advantages of REST include the abundance of auxiliary tools enabling automation of document generation based on source codes and the generation of client libraries using API for a variety of languages (including Java). Swagger is an example of such a library.

Web Services is a technology for the deployment of dispersed software components accessible via SOAP. Web Services components may be deployed using different programming languages, hardware and operating platforms. To facilitate the deployment of client applications, Web Service components are described in WSDL, which enables client application programmers to use automatic generators of communication codes. This solution is extended by UDDI – a specification of data bases allowing the capturing of information about Web Services available in the Internet (Figure 26.3).

The Service-Oriented Architecture concept is based on an assumption that business logic is not a monolithic program, but is split across many dispersed service components that are co-ordinated by a central control application. Service components are loosely linked to the control application, which is also referred to as Service Consumer. In addition, they may be shared by many applications (Figure 26.4).

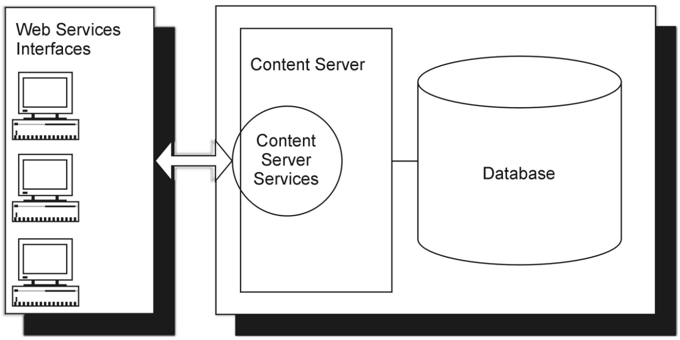


**Figure 26.3.** Web Service architecture
Source: Own elaboration.

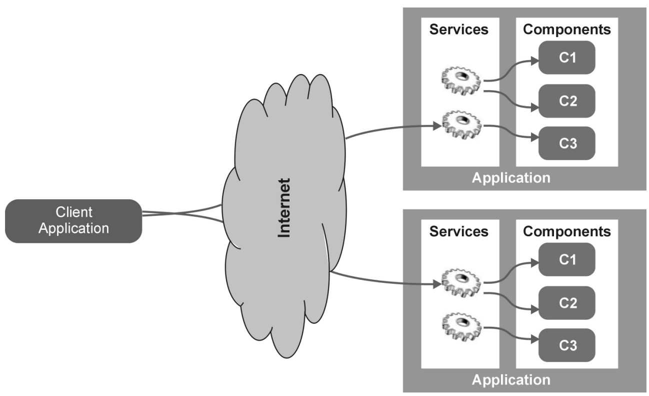


**Figure 26.4.** Service-oriented architecture
Source: Own elaboration.

Usually, service components are deployed and provided by independent entities referred to as Service Providers. The communication between the control application and service components occurs via the Internet. Most typically, the dispersed service components are deployed by means of CORBA, DCOM, EJB and Web Services, the latter becoming increasingly and rapidly popular. The figure below illustrates the most important elements of the service-oriented architecture. The business applications presented in the figure are remote service consumers, i.e. they perform their business process steps using remote service components. Service components are offered by service providers. The relationships between applications and components are of the many-to-many type – each application may use many service components and each service component may be used by many independent applications.

The common acceptance of the IT system architecture presented above resulted in a new model of IT business, which is based on a paid access to business service components used by developers of business-support applications. Although the situation on the market of billing technologies required by such solutions is still unstable, companies are increasingly appreciating such a revenue-earning method, stressing its advantages in the context of the intellectual property protection (service components are not physically delivered to consumers) and the continuity of revenue (the consumer pays each time when invoking the service).

Web Services is a framework for dispersed service components that constitute a basis for business applications within a service-oriented architecture. According to the commonly accepted definition, Web Service is a self-contained and self-documenting software component which may be registered in the computer network by its developer and then discovered by an application developer – a consumer – and invoked remotely. The Web Services technology is based on a number of correlated IT solutions, the most important of them being: SOAP – a communication protocol for sending remote calls, WSDL – a Web Service Description Language for distribution of network connection parameters, UDDI – a specification of data bases for registration of service components [Szczurkowski, 2010; Kałużny, 2008; Hansen, Gillert, 2008].

Representational State Transfer (REST) is a software architecture style derived from the experience gained in the process of HTTP specification development. REST is a software architecture model based on best practices for creating dispersed application architectures.

REST introduces such terms as a uniform interface, a stateless communication, a resource, a representation, HATEOAS. The model was proposed by Roy T. Fielding in 2000. It is used by many Internet application frameworks, e.g. Jersey, Ruby on Rails, Apache Sling, Sinatra, Django, RESTlet, RESTeasy and many other.

A RESTful web service interface is a characteristic element of REST, with service request parameters placed in the URL address path, not in the parameters section, as it is the case in classic GET or POST requests.

Assumptions:

- client-server architecture,
- statelessness (cache),
- caching,
- uniform access interface,
- everything is a resource (represented by an unambiguous URI),
- uniform interface (many nouns representing resources and little verbs describing permitted operations),
- stateless communication (the server does not create a session = easy scalability),
- resource representation – resources are abstract, but can be accessed by means of a defined representation (one and the same resource can be accessed in many representations, e.g. in the XML or JSON form).

Uniform interface:

- uniform resource identification / addressing,
- resource manipulation through its representation,
- self-descriptive messages (statelessness),
- relationships between resources (expressed in representations).

REST is an architectural style or an approach, the purpose of which is to minimize the latency (the time interval between the request and response) and network communication, while maximizing the independence and scalability of components. It is not an official standard or a method for designing Internet services, but only a concept. It determines a set of rules and principles of accessing service resources. Its strength is hidden in the solution, where no extension or any additional tools are needed for creating a web service. It does not concentrate on details of deployment or on technologies. All these features make this solution extremely popular. In order to decipher the name of the style coined by Roy Fieldin in his dissertation, let us refer to an abstract example of the Alfa Romeo website. For REST, AlfaRomeo156.html, identified by the URL address: http://www.alfaromeo.com/AlfaRomeo156.html, can be one of the resources. This resource representation is returned as AlfaRomeo156.html. The client application, having received the representation, is converted into a certain state. The client, through using the hyperlink, may access some other resource and the new representation places the client application into yet another state. Hence, the client transfers into another state with every new representation. The key words of the process lead us to the name the REST acronym stands for: Representational State Transfer.

REST-based applications may be deployed in many different technologies. System components communicate with each other via standard interfaces (HTTP for example) and exchange resource representations. The basic principles to be observed when designing an application include: a unique address of the resources, a multi-representation of the resources, using hyperlinks, cacheable, a stateless communication, a uniform interface and a multi-layered architecture.

## Conclusion

RFID-based solutions have been developed for many years now, mainly with regard to tamper-resistance. Microprocessor systems and cryptographic controls provide an increasingly better protection against unauthorized use. Owing to the combination of this technology with biometrics and modern document flow management methods, the project deliverables should remain useable for quite a long period after its completion.

Furthermore, the solution can be developed further on towards the latest trends in digital information management, thereby adding to the wide and long-term applicability of the project deliverables. Considering the nature of documents to be processed in the system designed under the project (multiple sensitivity levels, a diversity of information senders and recipients), it will not always be possible to eliminate the physical (paper) document form. Hence, the possibility (and requirement) of identifying and labelling such documents is and will be applied in practice in the nearest years.

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## Chapter 27
# The situation of people with disabilities in the Polish information society

*Krzysztof Leśniak*

## Introduction

The purpose of the paper is to present the situation of people with disabilities in the Polish information society. People from this group experience not only architectural barriers in their life, but the barriers posed by new technologies as well. Communication is a crucial factor in the disabled people's life. Namely information technologies enable people with disabilities to exceed their previous, often limited contact with the surrounding environment, while reducing their sense of social and economic isolation at the same time. This is why counteracting digital exclusion is such an important step towards overcoming these barriers. The proportion of people with disabilities in the information society is very low in Poland – this is what follows clearly from a survey conducted by the Central Statistical Office (GUS) in 2013 and published in such a detailed way for the first time. The Author has been studying the subject of people with disabilities for several years now. The results of surveys concerning the use of ICT in households in 2013 published by the Central Statistical Office support the Author's findings that there is still much to be done in this area.

## 27.1. People with disabilities in Poland

According to the Central Statistical Office (GUS) terminology, a person with disabilities in Poland is an individual who has had an appropriate certificate of disability issued by a competent institution or does not have a certificate like this, but experiences a restricted ability to perform the functions that are basic for the person's age (play, study, work, self-attendance). This is a very broad definition, specifying also the basic functions of a person who is not a disabled one[1].

[1] The following should be considered to represent common (basic), age-specific functions: for infants – correct reactions to external stimuli (cry, smile, adequate gestures and reflexes), for preschool age children – the ability to participate in games and plays in a peer group, for school age children – attending school and participation in all types of obligatory activities, for working-age people – occupation, learning or housekeeping, for seniors – basic self-care: grooming, shopping, preparing meals,

When defining disability, a medical model and a social model can be distinguished. The medical model considers disability to be a direct consequence of a disease or a damage, while according to the social model, disability is a result of limitations experienced by those affected, such as individual prejudice, restricted access to public buildings or public transport, segregation in the education system, or labour market solutions excluding people with disabilities [Barnes, Mercer, 2008, p. 7–27]. In the social model, „the causes of disability are not sought after in the individual, but in the restrictive environment rather, as well as in social, economic and physical barriers. Disability is not perceived as a phenomenon which categorizes people, but as a universal human experience. An approach like this exposes the fact that these people are not a minority" [Szluz, 2007, No. 24, p. 327]. There is a variety of classifications in respect of disability groups, but a commonly used one specifies the following categories: sensory impairments (blindness and visual impairment, deafness and hearing impairment, dual sensory impairment – deaf-blindness), physical disabilities (people with a damaged musculoskeletal system, people with chronic diseases of internal organs), mental disabilities (people with intellectual developmental disorders, people with psychiatric disorders, such as personality and behaviour disorders), complex disabilities (a combination of different disabilities listed above, e.g. blindness combined with an intellectual disorder, a person with a damaged musculoskeletal system, suffering from a psychiatric disorder, etc.) [www.forestap.republika.pl]. The Act on the Occupational and Social Rehabilitation and Employment of Persons with Disabilities [The Act, 1997] specifies three degrees of disability: major, moderate and minor.

People with disabilities account for some 15% of Poland's population, i.e. about 5.5 million, out of which around 1 million have never been issued a disability certificate, but consider themselves to be disabled[2]. The overall number of people with disabilities aged 16–74 exceeds 2.7 million[3]. Hence a conclusion, that the remaining 1.8 million represent the non-working age part of the population. On the other hand, according to GUS, there were more than 30 million healthy people aged 16–74 in Poland in 2013.

The participation of people with disabilities in the labour market keeps growing in Poland. The economic activity rate of working-age people with disabilities increased from 22.1 to 26.4 over the years 2006–2011, the employment rate –

etc. [GUS, Narodowy Spis Powszechny Ludności i Mieszkań 2011, Zakład Wydawnictw Statystycznych, Warszawa 2012, p. 34].

2 The 2002 National Census data, [GUS, Narodowy Spis Powszechny Ludności i Mieszkań 2011, Zakład Wydawnictw Statystycznych, Warszawa 2012].

3 A definition narrowed for the survey conducted by GUS in 2013 through the adoption of a methodology different than the one used in the National Census in 2002, when 5.5 million people with disabilities were identified, i.e. ~ 15% of the total population

from 18.2% to 22.3%. Consequently, the unemployment rate dropped from 17.3% to 15.5%[4]. In 2014, the economic activity rate of working-age people with disabilities was 27.1%, the employment rate – 22.8% and the unemployment rate 16.1%[5]. Economic activity is correlated with education to a considerable extent: more than 50% of the disabled with a university degree are employed, only 25% of those with a secondary education, while in the less educated groups the rate is even lower. As regards the correlation between employment and the disability level, people with minor disabilities are most active, the employment rate being lowest in the group with major disabilities.

## 27.2. Information society

The literature of the subject defines the information society in many different ways. The definition provided in the IBM Community Development Foundation report is one of the most popular: "Information Society: a society characterised by a high level of information intensity in the everyday life of most citizens, in most organisations and workplaces; by the use of common or compatible technology for a wide range of personal, social, educational and business activities, and by the ability to transmit, receive and exchange digital data rapidly between places irrespective of distance"[6]. Information society is a term referring to a social and economic formation, where the productive use of information assets and the knowledge-intensive production play a dominant role [Kubicek, Herbert, 1999].

The development of ICT increases digital exclusion, the latter affecting many different areas of life. The surveys of GUS describing some selected aspects of the information society development in Poland in 2013 give a basis for a broad analysis of the participation of people with disabilities in this development. The findings presenting the situation of people with disabilities in the information society are summarized in 12 tables and cover the following areas: computer usage, the frequency of computer usage, the place of computer usage, the Internet usage, the frequency of the Internet usage, the place of the Internet usage, accessing the Internet outside home or workplace via mobile devices, purposes of using the Internet for private purposes, the usefulness of information found in the Internet, people failing to use the Internet grouped by reasons, using the Internet

4 GUS BAEL – average annual data of the years 1993–2014 for working-age people with disabilities [www.niepelnosprawni.gov.pl].

5 GUS BAEL – average annual data of the years 2014 for working-age people with disabilities [www.niepelnosprawni.gov.pl].

6 Społeczeństwo informacyjne w Polsce. Wyniki badań statystycznych z lat 2004–2007 [Główny Urząd Statystyczny, 2008, p. 5].

in contacts with public authorities, users of the public authorities websites grouped by the purpose.

The analysis of the situation of people with disabilities in the information society should be commenced with the computer usage issue. One should remember that people with disabilities living within the society represent a group, which is forgotten or not taken into account very often and thereby most exposed to exclusion from the information society. This is why it is essential to enable people with disabilities to enjoy full participation in the social life through – among other measures – ICT training courses, which, although available, are not meeting the needs of the disabled.

It should be stressed that as much as 60% of people with disabilities aged 16–74 have never used a computer. In the population of people without any disabilities, 31%, i.e. nearly 9.5 million have never used a computer.

Hence, there is an immense difference between people with and without disabilities, showing the extent of digital exclusion which affects the disabled in particular. The phenomenon of digital exclusion contributes greatly to this group's exclusion from social and economic life. Figure 27.1 illustrates the structure of people without and with disabilities aged 16–74 in a breakdown by those using and not using a computer.

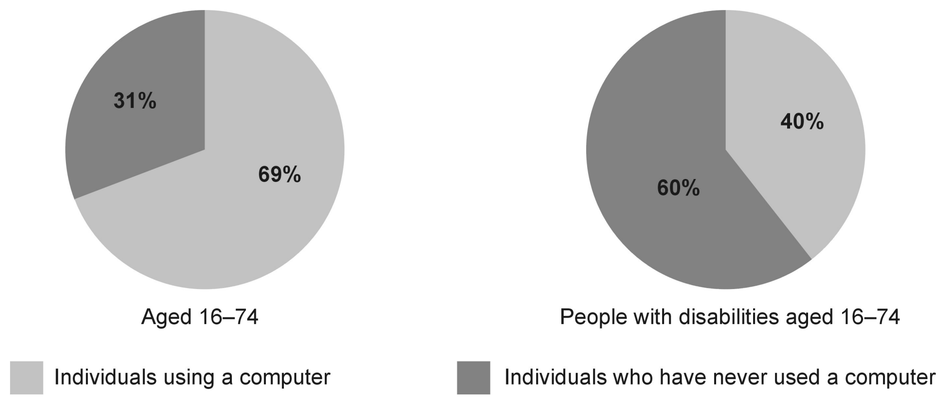


**Figure 27.1.** People without and with disabilities aged 16–74, using and not using a computer in Poland in 2013.

Source: Author's analyses based on: [Główny Urząd Statystyczny, http://www.stat.gov.pl].

In the 16–74 age group, computer users account for 40% of people with disabilities, i.e. more than 1 million and 69% of people without disabilities, i.e. 21million. The frequency of using a computer over a 3 month period[7] is 907 thousand, i.e. 32.8% for the disabled and 63.9%, i.e. 19.5 million for persons without

[7] The past three years as of the date of the survey.

disabilities. As regards the place in which a computer was used over a 3-month period, most persons with a disability, namely 877 thousand, i.e. 31.7%, used computers at home, while in the population of persons without disabilities – nearly 19%, i.e. 61.9%. Workplace (a place other than home) was indicated by 147 thousand of those with disabilities, i.e. 5.3% and 21% of people without disabilities, i.e. 6.5 million. Persons with and without disabilities use computers: at other persons' homes – 60 thousand (2.1%) and 2.8 million (9.4%) respectively, at the place of education – 37 thousand (1.4%) and 2.4 million (8%), other places (Internet cafes, libraries, hotels, airports) – 27 thousand (1%) and 1.3 million (4.3%). The surveys conducted by GUS prove that there is still much to be done in this field.

## 27.3. Persons with disabilities in terms of the Internet access

The Internet as a medium is an important source of knowledge, information and – first of all – a means of communication. To be able to use the Web, it is not enough to be connected to the Internet: the access to the assistive computer technology is needed first of all. IT competences, i.e. computer and Internet skills are no less important. Unfortunately, the IT competence is often confused with the information competence and as a result, the weight of considerations regarding the new media use is shifted towards technical skills, the idea of the information society development being narrowed down to the subject of infrastructure [Kędzierska, 2004, p. 82].

Attention should be paid to the problem of making websites accessible to persons with disabilities, especially in respect of the informational content display. Here, it is worth referring to the legislative perspective initiated by the World Wide Web Consortium (W3C)[8] based on the Web Content Accessibility Guidelines (WCAG2.0), which introduces the requirement for public authorities' websites to meet the needs of people with disabilities. W3C has specified guidelines concerning the assistance in accessing the contents published in the Internet.

It should be stressed that the opportunities and benefits offered by the Internet are priceless for persons with disabilities. Occupational development (teleworking) and access to education are those worth special mention, particularly in case of people with impaired mobility. The information society progress generates a new path for people with disabilities in the field of occupational development. Telework arrangements are remarkably convenient especially for per-

[8] The Web Accessibility Initiative (WAI) was launched by the World Wide Web Consortium (W3C) – an organization establishing standards for writing and transmitting WWW sites. Today, W3C incorporates more than 400 organizations, companies, government agencies and universities across the world.

sons with the musculoskeletal system problems. Telework, i.e. remote work, breaks the previous limitations of the place and time of work, which is highly important for people from this group. The idea of telework has been popularized by the European Commission at the end of the 1980s and the beginning of the 1990s, when numerous studies of the subject were financed with the aim of exploring the instrumentality of remote work as a means for economic activation and job creation in rural areas and underdeveloped regions, as well as for increasing the employability of women (as an opportunity to combine a career with the family life) and socially marginalized groups – as a chance for active participation in the social and professional life. Economic and social aspects were the main reasons why the subject of telework gained attention in the European Union [Piasecki, 2001, p. 62].

The idea of telework coexists with other innovative attributes of the information society, such as: e-commerce, knowledge management, trade and market globalization, virtual and learning organizations and teams, intellectual assets development, skills and knowledge development, smart organizations and other[9]. It is worth noting that 63%, i.e. more than 1.7 million people with disabilities have never used the Internet, while in the population of people without disabilities this rate accounts for 32%, i.e. 9.8 million. Figure 27.2 illustrates the structure of people without and with disabilities aged 16–74 in a breakdown by those using and not using the Internet in 2013.

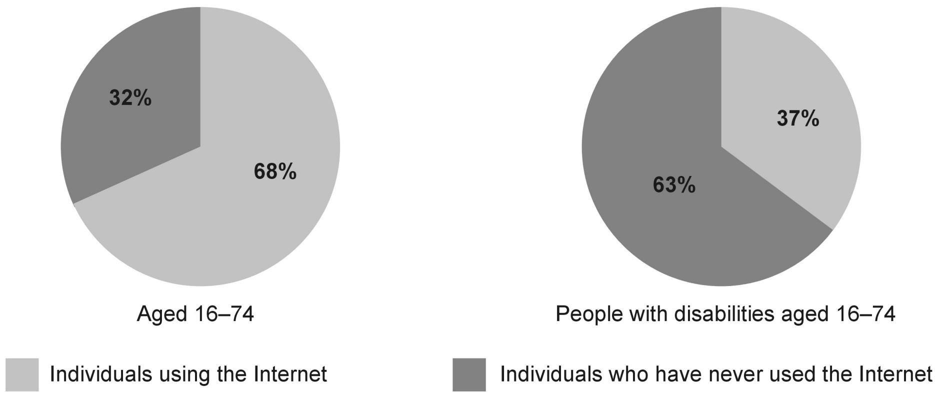


**Figure 27.2.** People without and with disabilities aged 16–74, using and not using the Internet in Poland in 2013.

Source: Author's analyses based on: [Główny Urząd Statystyczny, http://www.stat.gov.pl].

The proportion of Internet users in the population of people with and without disabilities aged 16–74 was 37% (more than 1 million) and 68% (more than 20 mil-

9 Status Report on European Telework. New Methods of Work 1999, AC990518, Telework'99, European Commission, August 1999.

lion) respectively. Regrettably, this is still too little, as far as people with disabilities are concerned. Poland compares poorly with developed countries in this respect.

There is a wide variety of barriers as regards the use of a computer and the Internet, but they may be divided into two main groups: soft and hard. Soft barriers are mainly those caused by the lack of knowledge and skills, self-exclusion and other mental barriers. The category of hard barriers, on the other hand, includes in particular insufficient access to appropriate hardware and software, as well as financial barriers. Figure 27.3 illustrates the structure of people without and with disabilities aged 16–74 categorized in a breakdown by the Internet literacy level, as of 2013.

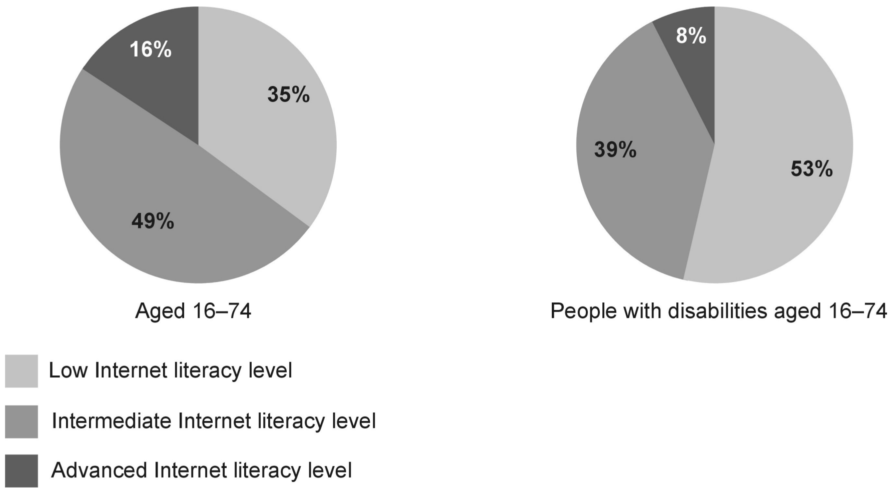


**Figure 27.3.** People with and without disabilities in a breakdown by Internet literacy level; Poland, 2013.

Source: Author's analyses based on: [Główny Urząd Statystyczny, http://www.stat.gov.pl].

According to the survey findings published by GUS, the proportion of Internet users showing various degrees of Internet literacy in the overall populations of people with and without disabilities accounts for 37% (947 thousand) and 68% (over 20 million) respectively. It is worth having a closer look at each of the literacy levels. Hence, 504 thousand, i.e. 53% of people with disabilities and over 7 million, i.e. 35% of people without disabilities show a low Internet literacy level. An intermediate Internet literacy level is declared by 370 thousand, i.e. 39% of people with disabilities and 9.9 million, i.e. 49% of people without disabilities. Finally, 71 thousand, i.e. 8% of people with disabilities and 3 million, i.e. 16% of people without disabilities declared an advanced Internet literacy level.

Paradoxically, digital exclusion affects in particular those, who might benefit from using the Internet most. Namely the disabled need the access to new technologies and new media much more than people without disabilities. Very often, the Internet is a window to the world for people with disabilities. They deserve communication with other people, the access to information, knowledge and entertainment in particular, since their disability deprives them of these vital aspects of life. The solutions aimed at the continual enhancement of the ICT skills of people with disabilities should be developed right now, since if neglected today, they are going to cost us much in the future. The prevention of digital exclusion, once initiated, will reduce the future costs and will enable the population of people with disabilities to participate in the social, economic and digital life. ICT literacy improvement centres need to be set up for people with disabilities. This group cannot be left to its own devices this time.

## Conclusion

People with disabilities demonstrate a very low level of computer and Internet skills. It should be emphasized that most websites are not accessible to people with disabilities – such assistance is provided at the sites of public authorities and institutions only. The contemporary labour market requires and expects its participants to show the basic computer literacy at least, the employers considering this to be an obviousness. Hence, in order to stimulate people with disabilities to greater activity, one should enable them to improve their computer and Internet skills on a continual basis. It is worth stressing however, that employers themselves are not fully positive about telework. Furthermore, the availability of assistive computer technology is by far insufficient. This is why counteracting digital exclusion of people with disabilities is such an important element of the information society development, as namely this group of the society remains unnoticed and marginalized.

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Chapter 28

# Change is good – unlearn is better

*Kurt Weiss*

## Introduction

New insights do not succeed by convincing the supporters of the old ones but by waiting for them to die out (Max Planck). Everybody knows the justifying subjunctive mood. If we just had! How could we have known? We all had agreed. Even if one of our colleagues had a different opinion. However, his arguments didn't convince. That clearly was our consensus. Nobody can blame us. We acted to our best of knowledge. Every step is perfectly documented and the minutes are signed by everybody. And still, we face a heap of ruins.

Even after our, in retrospective, fatal decision we could have taken an-other road. We should have listened to those who had said so. We did not! We should have. Our inertia was too big. Like Titanic heading for the iceberg. We were too sure of ourselves as was Titanic's captain. Endless discussions resulted in polemical accusations, reorganizations, dismissals, or even bankruptcy. The heap of ruins ended up as a memorial of our failure.

Is there an alternative? Yes: Back to the indicative of facts. Have we made mistakes? Yes. Can we learn from them? Yes, perhaps. Does it make sense to invest in finding all the failure's causes? Can we afford such an investment? Wouldn't it be much better to analyse thoroughly the present situation without prejudice and forgetting about history? To forget, however, is not enough. The past is to be deleted actively from our brains. We must unlearn if we do not want to drawn in the swamps of the irreversible past.

The process of unlearning is our topic. We shall see it to mean to ad-dress mercilessly and continuously certainties, prejudices, and habits. We must not erect dummies whose sole purpose is to brush aside the fact having lost sight of our goal and to stun ourselves by hectically spending all of our resources and energy in paving the road towards disaster. We shall learn that anxiety, (apparent) constraints, and blinders are poor advisers when it comes to eliminate radically the obsolete. Possibilities lying in the middle of the difficulties, confidence, and vista then show us the road towards a successful reconstruction from the ruins.

As always, examples help identify success factors. They include lifelong learning, lifelong unlearning, and the insight that in today's business change processes not only get faster but that they get faster faster.

What can be done? In the focus are the passion to learn, the courage to unlearn, a company culture where unlearning is under the direct auspices of the CEO, and the change competence of each and every stakeholder.

The subjunctive mood reflecting the past vanishes. It may be useful to structure the present in an attempt to scrutinize thoroughly various alternatives. The subjunctive mood directed to the future can serve as a Premortem telling us today what we should do next year if the project fails or as a Postgaudium reflecting the plans how to proceed if we succeed.

To learn from the past is good. To structure the future is much better. Unlearning enables.

## 28.1. Changes of Paradigm

Humanity, as is often said, has lived through three serious defeats. To begin with, Nicolaus Copernicus made clear, that our (not yet planet) earth is not in the center of the universe. Later Charles Darwin and Alfred Russell Wallace showed that man is not the center of creation either. Thirdly, Sigmund Freud implied that we are not even master in our own house. The former two reversals, empirically rooted, have in the meantime passed the test of times. The third defeat is still much discussed. New (specifically neurological) research, suggests that Homo sapiens eventually may gradually return to the cockpit of his self. In all three instances changes of paradigm where the consequences.

A forth example is the world of labor. Over the millennia, its changes were as frequent as they were radical. (Interestingly enough, they can still be observed across the globe if one travels from the technologically developed world to places where people live as they had lived centuries ago.) Radical they are. Not so much in the people's thinking than in their way of living. More specifically, today Information and Communication Technology (ICT) is the driver and the enabler of changes that are faster than ever in the history of humankind. The results may even pave the way to biotopes elsewhere in the universe offering niches where life as we know it has a chance to prosper. If we learn to unlearn.

### 28.1.1. The Copernican Revolution. My mind is made up. Don't confuse me with facts

During all ages men tried to understand the motions of the sun, the moon, the stars, and of whatever else one can see on the firmament. The first idea, understandably, was to assume that everything (excepting a few erratic objects like comets) turns around the earth. It prevailed till late in human history in spite of the ever more complex mechanism one had to assume to comply with the observed dawdles of the planets. Too strong was the pleasant compliance with an earth as the center of everything and too compatible it was with ideologies and religions who see Homo sapiens as a unique creation (see next section). To abandon these models in the 16th and 17th century, from Copernicus to Galilei, arguably was one of the toughest exercises of unlearning in human history.

The playwright Bert Brecht in his drama Galileo Galilei includes a scene that pointedly reflects the mental resistance against the new mechanics of the heavenly bodies. After a splendid dinner in Galilei's house to which he was confined by law, with a Cardinal and his suite as guests, the professor invited the Cardinal to look through the (in the Netherlands) newly invented telescope and see with own eyes the moons of the planet Jupiter. A scandal in the eyes of the Catholic Church because nothing can turn about anything but the earth. The Cardinal, however, did not care to look, because, as he argued, he knows Jupiter not having any moons whatsoever. Facts contradicting beliefs just do not exist. A prejudice is a better truth than an observation.

From hindsight one might ridicule the Cardinal's attitude. However, one should not forget that even today it is still quite popular. Even in our age of satellites and trips to the moon. And far beyond cosmological contexts. Unlearning is difficult.

### 28.1.2. Darwin & Wallace and Theory of Evolution. Because it cannot be what's not allowed to be (Christian Morgenstern)

Unlearning is difficult. Specifically stubborn and emotional was (and still is) the resistance against the theory published independently and simultaneously by Charles Darwin and Alfred Russell Wallace more than 150 years ago explaining the origin of species and its tremendous variability. Arguably the most consequential and singular thought in all empirical science. Live is created by coincidence to develop into ever more complex forms and shapes with the survival of the ones best adapted to the respective environments. A radically simple thought, based on an extremely large number of experimental results and causal arguments, that even today still is poorly understood, misinterpreted, or even (like the new ideas on cosmology by Brecht's Cardinal) flatly rejected. Including political motions to ban teaching the theory of evolution in schools.

Apodictically unmovable certainties, prejudices, habits, and ideologically based imaginary dangers obstruct the elimination of old ideas and hereby the possibility to fight real dangers rationally. Unlearning is not only difficult. It is also a survival necessity.

### 28.1.3. The World of Labor. If you could teach people to think differently, they would live differently (Robert Musil)

Unlearning is a survival necessity. An experience shared by most working individuals. Be it for the hunters and gatherers where it all began, be it for the foresters and herdsmen, the traders and craftsmen, or the workers in the industrial revolution who experienced the transition when, starting in the 18th century, manual work was taken over by machines. Later, in the 20th century, much more manual work has been taken over by industrial robots. Now, since the turn of the millennia, not only manual but mental work is in ever greater degree performed by "intelligent" machines. ICT takes over.

Difficult developments indeed. For instance, jobs getting obsolete. But the changes themselves fortunately, soon after the old procedures were replaced by new ones, created new jobs. Unlearning seemed, in this respect, to be relatively smooth sailing. However, difficulties were soon to pop up. Work became more intelligent. The institutions responsible for the formation (skills and knowledge) needed to perform the new tasks were (and are) far too slow, inert and hesitant to adjust contents and methods appropriately.

In addition and very influential, the role of women in society is in rapid change and far from being ready to match today's world of labor. (Specifically, a fact for leading positions and in ICT contexts.) This is by far not the end of the story. Unlearning political and societal structures against all kinds of prejudices and chokes is at least as urgent as ever. We are far from safe. Time presses.

## 28.2. Examples from Business

Unlearning is difficult in human thought, it is a survival necessity in their actions, and it is each company's success motor. What the paradigms are for the people (Tempora mutantur nos et mutamur in illis.) is for companies the continuously changing market driven by many strong and distinct forces. Companies, often paralyzed by their success, that tend to ignore these forces will have to yield sooner or later under the merciless pressure of their competitors and disappear. Others that know how to unlearn will never stop to comply with the changing conditions and survive profitably. Start-ups grab their chances and conquer markets or vanish noiselessly. Many stories can be told. The three that follow are examples aptly illustrating the role of unlearning in business.

### 28.2.1. Compact Disc. Where would we arrive, if everybody said: "Where would we arrive" and nobody would go to see where we would arrive, if we went to see? (Kurt Marti)

Jan Compaan, working for Philips Research, 1971 was in charge to investigate if the newly developed laser had practical applications in the field of digital information transfer. Specifically, one had in mind a new way to project picture slides on screens, because handling them was tiresome, slow, inflexible, and prone for mishaps. He found a solution. He punched small rectangular holes of different lengths (typically 10 $\mu$m) on a circular plastic disc (diameter about 12 cm) along concentric circular paths. Jan then placed the disc on a gramophone player to be turned at 78 rounds per minute and shone light from a (by then very expensive) laser on it to be reflected on a screen. The intensity of the reflected light was high outside the holes and much lower inside. A code was born.

Based on the prospect to conquer a much larger market than the projection of holiday pictures or data at scientific meetings, enthusiasm reigned. But then the question: what kind of market is to be addressed? Computer memories? Philips had (and still has) little experience with computers. Video projection with moving pictures? Systems were already on the market (e.g. with magnetic tapes carrying the data) but Compaan's solution was (correctly) expected to be far superior. On second thought the idea was nevertheless dismissed when serious doubts about the size of the market surfaced. Who wants to watch any given film repeatedly? Audio records therefore! Not surprisingly however, the Philips' Audio division was not amused at all. How can you dare to cannibalize our own flourishing business? It's a threat to the whole company if you kill the gramophone industry, a sustainable and worldwide bestselling cash-cow. Nevertheless, the cash-cow was killed mercilessly to leave space for a new one who's turnover and profit dwarfed the former one by orders of magnitude.

Unlearning had a great time. Analogue turned digital. Slide projection would have been a trivially small market, the one for video recorders' not much larger. Computer memories was a market without an in house basis and audio one that killed one of Philips' own excellent products. Inadequate or even wrong was the idea that the improved sound quality of the CD as compared to the gramophone record would be the decisive success factor. Handling and robustness turned out to win the day. The laser changed from complex and expensive high tech device into a maintenance free, cheap mass product. Unlearning was also needed to understand that the success could not be realized by Philips on its own. Cooperation with Sony and a global system standard were essential for the break through ten years after the original plastic disc had circled on Jan Compaan's gramophone (!) player.

And today? Again, unlearning is the call of the day. CDs are on their way into the Cloud. Which company will win the race?

### 28.2.2. Standard software. The future happens. Even without you

In 1972 five young postgraduate IBM employees proposed to their re-spective bosses to develop an integrated, business oriented standard software that can be customized, in a second step, according to the needs of the customer companies. IBM declined fearing to kill their own business and asked the five entrepreneurs, that's what they turned out to be, to remember that their contracts said to take care of the then cash cow: main frame computers. A chance to unlearn missed. A huge business chance missed.

The five persisted. SAP is what they called their start up. The standard software, once developed, could be copied at "no" cost (on CDs!) to be sold for a license fee. Parametrizing the package to the needs of the customer, aka customizing, crated a large new market offering SAP partners (IBM for instance) nice turnovers and profits.

Till 1992 SAP had grown steadily and was well on its way to become an important player in software business. 1992 was also the year when IBM missed a second chance to unlearn. The sales of the monolithic main frame computers was about to slow down drastically as companies started to prefer (for various reasons) flexible client server architectures for their IT services. IBM succumbed to a serious crisis. SAP, on the other hand, had foreseen the customers' new preference. They unlearned immediately and went back to square one to meet the new trend. Within a few months they replaced the "old" package called R/2 with the new one (R/3). The transition was radical. R/2 was not sold any longer. (Maintenance services for existing installations were still held available for more than 10 years). R/3's success was phenomenal. After seven years, in 1999, SAP's turnaround, profit, and number of employees had all been multiplied by a factor of ten. 1999 was the year when IBM had recovered from the crisis and was about to regain momentum.

And today? SAP again unlearns intensively. Companies have started to outsource their hardware to specialized companies. Software is operated in the Cloud. Furthermore, software is slowly if steadily not any longer bought but leased and paid as used. Unlearning in permanence. SAP is ready to go on.

### 28.2.3. Photography. If you are riding a dead horse get off (John Wayne)

Imagine you own in the 1990ies of the last century a decently running business that develops in a dark room negatives, enlarges and copies them for a lot of satisfied customers. It escapes your attention that digital photography is making its entrance. Your business has vanished from the map.

Kodak was founded in the 1890ies and developed in 1975 the first digital camera. But it did not unlearn. It has vanished from the map.

## 28.3. Unlearning

Unlearning is active. Unlearning eliminates. Unlearning is more than relearning. Yes, relearning is active too, but it does not eliminate. It opens new opportunities but without seriously questioning the old wisdom. Capacities are still absorbed by the traditional business and are dearly missed by the new one. Unlearning is radical. Relearning is gradual. Relearning asks for careful consideration and reflection. Unlearning is emotional and full of surprises. Relearning depends on disciplined work and diligence. It is rational and can be planned in detail. What is to be preferred? It all comes down to find the equilibrium between the uncritical enthusiasm for the new opportunities and the cautious and gradual development of the existing ones. Demolish bridges or strengthen and refurbish them? Both ways have their merits. Not doing anything is almost certainly the wrong option while compromises in most cases are too short-lived to be of much use.

### 28.3.1. Certitudes, prejudices, habits, and dummies. He who thinks he knows all the answers is out of date

Certainties belong to the most dangerous enemies of unlearning. With great success they impede all and every initiative to change anything. Everything is perfect, they imply. We always did it that way. Who are you to propose changes? We are the experts. Prejudices and superstition are of the same brand. At full moon the birth rate is highest. Gypsies are thieves. In my youth everything was better. Black cats cause misfortune. As does Friday the 13th. Planets are responsible for my destiny.

"It goes without saying" is the key phrase to be suspicious of. Or as Albert Einstein puts it: It is more difficult to destroy a prejudice than to split an atom.

Habits, inertia and routine are the enemies of actions needed to unlearn successfully. It is much easier to evoke a dummy, a scapegoat, the devil or other imaginary antagonists than to face the challenge. It does not make sense to kick the dog when you mean the master. Dummies don't fight back. A victory against wind mills is of no use. Just do it is Nike's credo. Nike was the goddess of victory in Plato's Greece.

### 28.3.2. Deconstruction – against anxiety, (apparent) constraints, and blinders. If you change the way to look at things, the things you look at change

In a crisis it is popular to look for causes and culprits. Hoping to avoid future crisises and to get rid of incapable collaborators one didn't dare to fire in calm times. Both endeavors, as experienced in countless cases, are of restricted help. Causes of crisises vary as influenza viruses. It is rare that people are really incapable. Rather, they are driven by inefficient organizational structures and bad leadership into positions where they have no chance to deploy their knowledge and their skills to the benefit of the company. And above all: neither looking for causes nor firing innocent colleagues solves the crisis.

Courage is called for. Courage to ban the anxiety in front of inevitable changes to be implemented, the courage to get rid of historically grown nonsensical constraints, and to dispose of the blinders that block the view on solutions hidden in the middle of the difficulties. Behavioral patterns are to be dropped, not people. Anxiety, constraints, and blinders are cause and culprits in one phrase. It's them to be deconstructed.

In 1752 Benjamin Franklin invented the lightening conductor. However, people were afraid of all kinds of imaginary collateral damage and stopped its installation by legal constraints. For decades houses still burned down. Ignaz Semmelweis' experience as a gynecologist made him conclude in 1847 hygiene to be the most influential parameter for the wellbeing (and more often than not) survival of mother and child at birth. Legal constraints based on prejudices and mobbing by jealous colleagues for years stopped this easily and cheaply implantable measure and brought its discoverer to the edge of psychical illness. When twenty years later hygiene finally became state of the art (also for surgery) man's mean life time doubled. Semmelweis sadly did not live to see this: he had died two years earlier.

Max Planck in 1900 put forward the quantum hypothesis. He of all people did not believe in it himself. He thought of it as an artificial mathematical device (a one trick pony) with no real value for understanding the behavior of nature. The old "truth" that nature does not make jumps (natura non facit saltus) was for Planck's conservative character an irremovable blinder hindering him to appreciate the experimental facts and their implications. Even Einstein could not convince him when he (1905), generalized the quantum idea to explain successfully the puzzling photoelectric effect. Not even after being awarded the Nobel Prize (1920) Planck's thinking would be thoroughly reconciled with the reality of quanta. Blinders at their worst.

An illustrative example from business was witnessed by the author. In a large retail company standard software had been implanted replacing dozens of decentralized, often respectively incompatible, specialized, nonintegrated solutions. For their master thesis three students had been assigned the task to establish quantitatively the return on investment (ROI) after nine months of the new software's operation. Result: it conformed to the expectations. So far so good, if a little bit boring. But there was a surprise. The students during interviews encountered quite an amount of dissatisfaction among the company's staff. What had happened? Driven by the suspicion the new system to be bugged some of the employees confronted the results delivered by the new installation with those of the (local) old one. Of course they found discrepancies as the data in the old system had not been kept up-to-date. Should one have switched off the old system as soon as the new one was operative? A good idea at first sight but not so good at all on second. The old system had worked perfectly. Everything had been ok. Why then switch it off (data can be kept current without too much effort)? What had gone wrong? the students asked. Here is their insightful answer: Nobody had cared to help the employees to free themselves from their prejudices, their anxiety, and their general resistance against change. One had for-gotten to explain the advantages of the new software for the company and all its stakeholders. Additional schooling was immediately organized. The blinders dropped. The staff had gained trust in the new software. The students' curiosity and open mindedness had helped to avoid considerable damage to the company.

A (mild) case of whistleblowing. Whistleblowers are excellent drivers of unlearning. Whistleblowers should be rewarded (and certainly not fired).

### 28.3.3. Reconstruction – confidence, possibilities, and prospects. Those who can't change their minds, can't change anything

The Phoenix rising from the ashes is a metaphor for the miraculous reconstruction of something thought irreversibly lost. Unlearning, in contrast, means avoiding losses actively. The city of Dresden had to be reconstructed from scratch. Rome was declared "open city" and persisted practically undamaged thanks to the confidence of the people and their courage.

Unlearning thrives on confidence. From the confidence to discover possibilities, to see solutions. Constructive skepticism enables unlearning. Like Louis Pasteur who in the 1870ies conceived the idea prophylaxis to be more efficient than therapy. Vaccination is the name of the game. Like Henry Ford who did no market research because, as he quipped, people would have asked for faster horses. It was his entrepreneurial genius to see that no horse could compete with a combustion engine, and his confidence in engineering and in enabling talents that made the auto-mobile a reality.

There was, of course, something else needed to turn the car into such a success. The wheel? No! The hero was not the proverbial someone in prehistorical time inventing the wheel. The wheel was no invention. Trunks and branches on trees are round. Ball-like pebbles are found on the beach and in rivers. The car became possible because clever engineers avant la lettre drilled circular holes in circular objects and connected them with a round bar. The axis was born. It was now possible to push or pull a car continuously with no need to carry every few meters a roller from the front of a platform to its back. The speed of transportation increased manifold. The inventors of the axis, their names lost in history, had seen a new method to translate without interruptions linear in rotational movement. Transportation was never again what in had been hitherto. Like the photography who has left the dark room for good.

## 28.4. Success factors

The past cannot be changed. Can one learn from the past? Many say so while others doubt that past errors and mistakes are good teachers. If one really had learned then it would have helped. Had one? Not likely, because the world has changed too much for old recipes to be of much help. New thinking is required. New acting. It is today that the future can be shaped. Today only, because the future, when it is here, it is over. Success we have, if we unlearn the mistakes and errors from the past. Or in the words of Samuel Beckett: Ever tried. Ever failed. No matter. Try again. Fail better.

### 28.4.1. Lifelong learning. What our fathers created in their times was new. Let's stay true to them and again create what's new (Mani Matter)

Lifelong learning is the oxygen for success. It's the main road to the skills and the knowledge that keep success on the agenda. They are the growth factors of the capital you need to finance the future.

You are born. You know little. Your knowledge is a small island in the huge ocean of ignorance. You continue learning. Your island of knowledge grows. You are curious. The island grows again but still is barely visible in the ocean of ignorance. But: the coast gets longer. New voyages become possible. You curiosity sets sail. To new voyages. To new successes.

### 28.4.2. Lifelong unlearning. If you always do what you have always done, you'll always get what you've always got (Henry Ford)

Unlearning is an attitude. It's a culture. An attitude for the individual, a culture for the company. It's the active willingness to always question the usual and to renew it. If Kaizen stands for change and improvement, unlearning stands for survival.

The philosopher Friedrich Nietzsche, the philosopher economist and publicist Karl Marx, and the economist and politician Joseph Schumpeter called radical revolutions of societal structures acts of creative destruction. In business unlearning is a renewal that conquers a market, and does not destroy it. Creative conquest.

Consider fashion that is reinvented twice a year. Or look at the HILTI Company as it brought together chiseling and drilling in one single handheld device. An act of unlearning in the very conservative construction industry rewarding HILTI with the leadership for fastening technology. The invention of the pneumatically driven piston and other technical innovations, the concept of direct selling at the building site, and the recent transition to a new business model (leasing instead of selling the equipment) consolidated the company's position as a worldwide leader in its field. All together it is nothing less than unlearning the old method of fixing something on a wall of concrete or steel. Selling clumsy bolts and heavy machines with strenuous handling has turned into a market for integrated fastening systems with an enormous overall increase in speed, efficiency, and effectiveness.

To conclude this section, remember one of the undisputed champions of unlearning Steve Jobs who, within ICT, all but monopolized the market with a high frequency series of unlearning events. Apple today is one of the most highly valued companies. And counting.

### 28.4.3. Velocity. It takes all the running you can do to keep in the same place (Lewis Carroll)

In 1965 Gordon Moore, one of the founders of Intel, predicted the stor-age capacity and the calculation speed of calculation of integrated cir-cuits to double every two years while their prize will halve. The prediction turned true and after 50 years still is. The corresponding numerical factor of change is an incredible 35 million. Applied to cars it would mean that they would cruise at three times the velocity of light consuming a ridiculous 3 microliter of gas per 100 kilometers, and would sell at about one hundredths of a cent. Absurd for cars but a vivid picture for the changes in the digital world. Computer do not get faster, they get faster faster. And with them the rhythm of business.

A rhythm that challenges people. Or, too often, strains them. When American Indians travel, every now and then, or so the legend goes, they have to wait a few days till their soul has also arrived. Today's business is no place for Indians. Business processes get faster and faster. And so does communication. Communication was always important. Today it tells success from failure. Again, ICT takes over.

Velocity is more than speed. It has a direction. (Velocity is, technically speaking, a vector.) Not only speed has increased but also the frequency of direction changes. Goals and plans are modified in ever shorter intervals, reorganizations chase each other. The flexibility imposed on people increases. Unlearning as a survival factor wherever you look.

## 28.5. Actions

For ever and ever one has to change, to renew, and to rejuvenate in order not to harden insists Johan Wolfgang von Goethe. Nicely put. Here we say: learn to unlearn! How? There are many ways. Here are a few rather general suggestions.

### 28.5.1. For the society. Educate people and the world is a better place to live

Formation starts at the latest in Kindergarten and ends at the earliest with memory training for senior citizens. Every person should always have the possibility to learn what he needs to learn and what corre-sponds to his inclinations. Useful contents compatible with the fast changing job market and "superfluous" ones important for the individual. The monies needed should not stay level over time or, horribile dictu, even be reduced. The have to be increased. Not by a meager tern percent per year but by factor of ten. A utopia? Yes, but a necessity in a world worth living (eutopia?) has to get a chance. A truly global effort is needed. Without forgetting local conditions and while respecting local mentalities. Everybody is challenged. And there is no better advice than the poetic words of Antoine de Satin Exupéry: If you want to construct a boat don't call for men to collect wood, to assign tasks and to schedule work, but teach the longing for the large, boundless sea.

### 28.5.2. For the CEO. You get what you measure (Jack Welch)

We said so before: unlearning is part of the company culture, it co-defines the cooperate identity. It is a strategic non-monetary value. An Intangible Asset. In many companies a member of the managing board or the board of trustees is responsible for research and development. Likewise one of them should be in charge of unlearning. Lifelong learning, as many have understood, is a task for the managers and so should unlearning be. Unlearning is to become one of the salary and bonus evaluation criteria. It should become part of the budget discussions that in general are time consuming and complex. Too time consuming. Too complex. Why not unlearn budget discussions. Jack Welch suggests to restrict them to just two items: increase the present year's turnaround and profitability, and surpass the competition. And apply this advice at the same time to unlearning: unlearn it better than last year and better than the competition. Change is good, unlearning is better.

### 28.5.3. For you. The head is round so that we can change the direction of our thinking (Francis Picabia)

Creativeness is rooted in people. Unlearning is creative. It means to conquer inventively new territories, new markets. Thoughts and emotions are the drivers. Curiosity, the art of experimenting, and playfulness are the forces behind. Newborn babies are their champions. That is how they can find a road into the complex world and survive. As they grow and get older, unfortunately, more often than not they tend (to be educated?) to neglect these assets. They start to know how things work. A sure sign that unlearning is called for and the rejuvenation of lost creative forces. In life, but as well in their professional activities. Companies need it. Only if the stakeholders never stop to unlearn creatively will the shareholders be satisfied.

## Conclusion

Tell me and I forget. Teach me and I remember. Involve me and I learn (Confucius). The justifying, subjunctive, and plaintive mood, is a bad recipe to find the ascent to success. Nostalgia is a bad consultant too. Catastrophes are likely to happen if everything continues as always. The world is a world of possibilities. Skepticism and openness to critique are the keys to unlock them. The mental immune system's task is not only to keep away deleterious inputs but also to be open towards useful ones. The task is to develop tools able to tell the formers from the latter that help to defend against the harmful while incorporating the beneficial ones. This essay may be a starter. From here to applicable rules and to their implementation is a long but rewarding road. Technology and innovation will have their part but prominently the journey will be guided by our emotions. Let's go for it.

i In "Kurs auf den Eisberg", pendo, 1984, Joseph Weizenbaum draws a very skeptical picture of ICT, that predicts the worst and hopes for a miracle. Today, more than 30 years later the world and the human race still exist. Without a miracle. What can we learn from this?

ii Thomas S. Kuhn in "The Copernican Revolution", Vieweg 1981 (English original: Harvard University Press, 1957) offers a thorough and deep analysis of a change of paradigm in science.

iii Story told in "Hasso Plattner im Gespräch. Dem Wandel voraus", Galileo Press, 2000, pp. 85–101.

iv A vivid account of this turnaround is "Who Says Elephants Can't Dance? Inside IBM's Historic Turna-round" by Lou V. Gerster, Harper Business, New York, 2002.

v The movie "Roma citt? aperta", 1945, by Roberto Rossellini is a fascinating document in this con-text.

vi A instructive collection of misunderstandings, prejudices & misguided thinking is "Lexikon der populären Irrtümer" by Walter Krämer und Götz Trenkler, Eichborn 1996

vii An introduction to this concept can be found in Jürgen H. Daum in "Intangible Assets", Galileo Business, 2002.

viii An inventory about the concept "Beyond Budgeting" was edited by Jürgen H. Daum, Verlagsbuch-handlung München, 2005

ix Jim Collins in "Good to Great", Harvard Business, 2001, based on empirical research singles out criteria that turn a good company into a great one. To these criteria we propose to add unlearning.

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