

ISSN 2080-7279  
2013 Volume 05 Number 02

# foundations **2** /2013 of management

INTERNATIONAL JOURNAL

fom



WARSAW UNIVERSITY OF TECHNOLOGY  
FACULTY OF MANAGEMENT

# Foundations of Management

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## Frequency

Published four issues per year

three regular and one special issues prepared by invited editors

## Internet

The International Journal - Foundations of Management

is currently available on-line at:

<http://www.fom.pw.edu.pl/s110/foundations-of-management>

<http://bcpw.bg.pw.edu.pl/dlibra>

<http://www.degruyter.com/view/j/fman>

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tel.: +48 22 234-70-83

fax: +48 22 234-70-60

ISSN 2080-7279

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Printed In Poland

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*Foundation of Management (FoM) journal was established at the Faculty of Management at Warsaw University of Technology in order to provide an international platform of thought and scientific concepts exchange in the field of managerial sciences.*

*This new publishing forum aims at the construction of synergic relations between the two parallel trends in managerial sciences: social and economical – originating from economic universities and academies and the engineering trend – originating in from factories and technical universities.*

*Three of the great representatives of the engineering trend in managerial sciences - American Frederic W. Taylor (1856-1915) – developer of high speed steel technology and the founder of the technical with physiological trend in scientific management, Frenchman Henri Fayol (1841-1925), the author of basics of management and the division and concentration of work as well as the Pole Karol Adamiecki (1866-1933) graduate of the Saint Petersburg Polytechnic University and the professor of Warsaw University of Technology, creator of the time-scale system elements scheduling theory and diagrammatic method as well as the basics of the division of work and specialization – have, on the break of the XIX and XX century, all created the universal foundations of the management sciences. Therefore the title of the Foundation of Management is the origin of the scientific and educational message of the journal that is aimed at young scientists and practitioners – graduates of technical and economic universities working in different parts of Europe and World.*

*The target of the establishers of the Foundation of Management journal is that it will gradually increase its influence over the subjects directly linked with the issues of manufacturing and servicing enterprises. Preferred topics concern mainly: organizational issues, informational and technological innovations, production development, financial, economical and quality issues, safety, knowledge and working environment – both in the internal understanding of the enterprise as well as its business environment.*

*Dear Readers, Authors and Friends of the Foundation of Management – our wish is the interdisciplinary perception and interpretation of economic phenomena that accompany the managers and enterprises in their daily work, in order to make them more efficient, safe and economic for suppliers and receivers of the products and services in the global world of technological innovation, domination of knowledge, changes of the value of money and constant market game between demand and supply, future and past.*

*We would like for the Foundation of Management to promote innovative scientific thought in the classical approach towards economic and engineering vision of the managerial sciences.*

*The Guardian of the journal's mission is its Programme Committee, which participants of which will adapt to current trends and as an answer to the changing economic and social challenges in the integrating Europe and World.*

*Tadeusz Krupa*



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## INSOURCING AS A NEW TREND IN GLOBAL BUSINESS

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**Abstract:** In the face of world economic crisis, it is worth considering ‘what changes in thinking are needed to revive the global economy?’ Traditional management methods have already lost much of their potential. Keeping the compliance of job category with human nature is an important factor supported by insourcing. The purpose of this study was to answer the question whether the current economic situation in the world is more profitable to firms sending domestic jobs overseas, or perhaps – in the end – it is better to use insourcing services, providing employment to workers in their home countries.

**Keywords:** insourcing, outsourcing, co-sourcing, transatlantic exchange, repolonisation of economy, depopulation, ecology, unconventional fuels, Total Participation Management, reindustrialisation.

### 1 Introduction

The economic slowdown, declining consumption and production are forcing entrepreneurs to change their way of thinking about the management of companies. Shared long-term admiration for the ease of communication and exchange of information through computer networks, in particular, a global system of interconnected computer networks (the Internet), enables teamwork of a global nature, and it seems necessary for most companies to compete within global markets.

Communication techniques are constantly being improved, which makes global partnership and teamwork much easier than ever before. At the same time all industries and markets around the world confront real keen competition, by introducing new materials and products, linking people and resources, *ipso facto* making it difficult to conduct local, private and often family businesses successfully, also they have concern on how to attract customers.

Last global economic recession has forced customers to tighten their belts, but their needs and expectations for higher quality goods and services have also increased. Therefore, it is essential for businesses to more effectively manage with competitors. The opening up of new markets is very often connected to a new government, but also consumers all over the world learn about new products from radio, TV, on the Internet and through contacts with foreign tourists. Today’s customers expect more socially responsible and environmentally friendly actions from businesses. If we take into consideration the alarming environmental changes,

it must be stated that this is an exciting time for companies wishing to introduce new products, which are more environmentally friendly, and more successfully compete in the global markets. When the companies create a more competitive infrastructure, it will generate new jobs and new opportunities in the areas of purchasing, operations, logistics and supply chain management.

This article intends to answer the question ‘how to become a better manager in today’s global economy?’ Looking at the activities of many companies that have been successful in Poland and abroad, we can see the fundamental change in management principals during the last 2 years. These changes are introduced gradually and carefully, after the necessary calculation was made and taking into account many factors that might affect the new profit strategy.

A new approach for the company management depends on the gradual abandonment of the, still popular, outsourcing and move on to insourcing, by bringing many jobs performed in other countries back to home – mostly the jobs outsourced to Asian countries. This could have major strategic importance for a company as well as for the country, because unemployment rate will get reduced which in consequence results in a chance to reindustrialisation contributes to the country’s economic growth.

Overview of the organisational management of the well-known companies around the world in the past 2 years and most of all realised the benefits of insourcing and leads to the conclusion that this form of doing business is essential for economic recovery, but if it is to benefit a particular company, it cannot be hastily

adopted strategy without prior profitability assessments. It means that many companies have to introduce co-sourcing strategy, i.e. combining insourcing, where a service is performed by staff from inside an organisation, and outsourcing, where mostly simple business services are performed by an external service provider.

## 2 Overview of sections

Each of the presented sections focuses on the advantages and disadvantages of traditional management by using outsourcing, the examples of large foreign companies after a careful calculation and for various reasons considered in-house production more profitable than outsourcing, and brought home projects that are performed in other countries. This article proposes insourcing which should be gradually introduced in place of outsourcing. Those who are conducting business activities in Poland as well as senior leaders who have achieved success in the country and abroad were also described. Subsequently, the industrial development difficulties resulting from high unemployment, demographic decline and a large scale emigration were defined. At the same time a positive image of Poland viewed by foreign businessmen was presented, which is reflected in the large foreign investments in Poland. This article also reports conclusions regarding the efficacy of insourcing acquired from the analysis of information about Poland and the world. Finally, it seems that the most advantageous form of business – especially for large companies – is co-sourcing. An important observation is that insourcing can contribute to reindustrialisation in different countries.

The introduction (Section 1) gives a brief overview of the background with particular emphasis on the need for reorganisation in the companies, which are major component of economic recovery. The whole introduction contains the scope and direction of this study. A new approach to business activities was suggested that would likely replace the present conventional outsourcing method. The new approach is not only to improve a specific company's situation, but also should bring benefits to the country. This section contains a short description of other sections of the article.

Section 3 describes the traditional managing methods using outsourcing. It examines the effects of globalisation from the perspective of different groups of workers and brings forecasting of future events. The last subsection

of this section describes the social effects of outsourcing.

Section 4 defines the concept of insourcing and indicates typical situations in which it can be applied. Examples of companies that have already employed insourcing or tending to its application and Deloitte Research analysis, which show an upward tendency of insourcing are presented in Section 5.

Section 6 brings an answer to the question whether the present century is the age of insourcing. However, the investigations of Section 7 testify that insourcing will be more effective if entrepreneurs apply the full participation of workers in the company management.

Section 8 points out that the revival of industry might cause environmental problems, arising mainly from the currently used technologies for extraction of unconventional fossil fuel resources. The subject of Section 9 is business in Poland. The examples of business leaders who invest successfully not only in the country but also abroad are described, included the cooperation with Fiat Automobile Co., which – to the detriment of Polish workers – applied insourcing, partially relocating car production from Poland to Italy. Section 10 provides an answer to the question: if Poland had an opportunity for reindustrialisation, would it benefit from insourcing? An analysis of the overall situation was made, pointing out the difficulties in the development of industry from high unemployment, demographic decline and large scale emigration. The interest of large foreign companies investing in Poland offers hope for the revival of economy. In summary (Section 11) the final conclusions are presented, pointing to insourcing as a proper form of doing business in the current situation, but perhaps some of the services should be left to outsourcing. Therefore, before deciding to bring home, detailed calculations have to be made, examining the cost-effectiveness of such a change for a specific company. The last section contains bibliography.

## 3 Traditional management methods through outsourcing

In a global economy for a number of years, we have had a tendency of relocating investment funds and companies outside the country and home markets, thereby enabling the interconnection of different markets throughout the world.

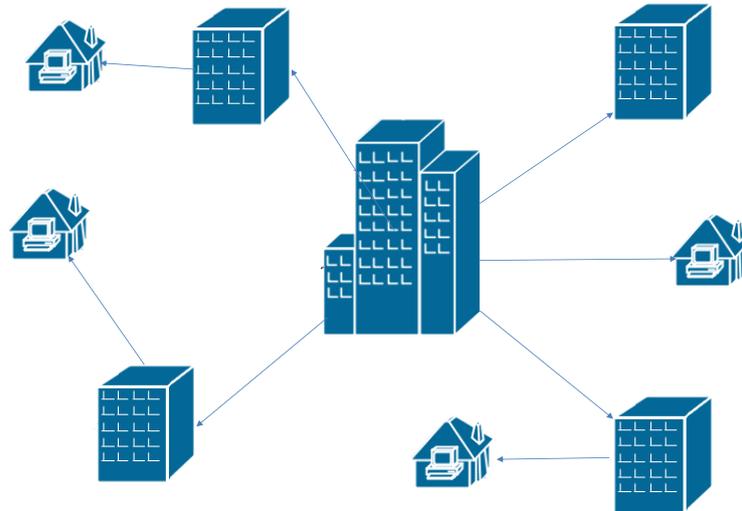


Figure 1. Outsourcing  
(source: own elaboration)

Among the main reasons companies opted to outsource is cheaper overseas labour, e.g. in Asian countries, than in their home countries. This way of doing business is called outsourcing.

The extensive use of outsourcing services from design work to the cottage industry is represented symbolically in Figure 1, where the parent company is located in centre and the arrows indicate the companies participating in the commissioned work (the smallest buildings symbolise simple works, not requiring any special skills). Proponents of globalisation believed that the positive aspects of such procedure can help developing countries to 'catch up' much faster with industrialisation through increased employment and technological progress, and the Asian economies are often singled out as examples of globalisation success. In contrast, opponents of globalisation argue that it weakens national sovereignty and allows rich countries to send domestic jobs overseas where labour is much cheaper. A comprehensive description of the globalisation effects can be found in Ref. [1]. Apart from the benefits many risks are recognised that can have an impact on the future of businesses and entire societies.

What is the truth about globalisation? Is it a progress or speculation? To a large extent it depends on our own individual view on the matter of globalisation and outsourcing. It is worth examining this problem from the point of view of different groups of employees.

For business leaders and representatives of the economic elite, globalisation is good. Cheaper overseas labour

allows them to build factories in places where the labour costs and health care are low, and then selling the finished goods in places where wages are high. Profits will increase due to the significantly reduced wages for employees that causes stock prices increase, and there by big profits may be expected by institutional investors and some wealthy individuals. But globalisation does not concern just managing directors and high-ranking individuals. Furthermore, it goes far beyond the immediate area in the global market. For employees of technology centres in India as well as for employees of automobile factories in China, globalisation means that they must compete with job applicants from all over the World. Some of these changes in globalisation in the United States are due to the North American Free Trade Agreement (NAFTA). NAFTA, among others, shifted car production from the United States to Mexico, a developing country, where wages are much lower than in the United States. After few years later, some of these jobs have been transferred to third world countries in East Asia, where wages are even lower. In both cases, car manufacturers expected that consumers in the United States will continue to purchase these products by paying according to American prices. While critics of globalisation believe that globalisation may entail the loss of jobs in developed countries, those who support globalisation argue that employment and technology import to the developing countries accelerate industrialisation and also increase the standard of living of those populations. In the battle of globalisation, outsourcing is a double-edged sword. On the one hand

edge, low wages in other countries allow the sale of clothing, cars and other goods at reduced prices in Western countries, where shopping is very deeply rooted in their culture. It allows companies to increase their margins. At the same time, the customers can save money when purchasing these goods, which enables some supporters of globalisation to give statements that sending work abroad contributes to the reduction of wages as well as reduce price levels. Low-income employees may also benefit from such profits as, for example the increase in stock prices. Many employees have shares in investment funds and when companies outsource jobs outside, the share prices of these companies rise in the stock market, so does the value of the investment funds. The beneficiaries are not only managers but all share holders of those companies. The most vulnerable are ordinary workers. A colourful description comes from Lisa Smith [3], writing that ‘public audit institutions encourage business leaders to see that the tide does not necessarily lift all boats’. In many cases, low-income employees are suffer the most, because they do not have transferable skills. Therefore, it is considered to retrain workers, but it is easier to say than to be done.

### 3.1 How does the future look like?

One can expect an increasing flow of cross-border money, information, people and technology transfer. We are dealing with a classic situation where the rich get richer and the poor are becoming poorer. While the global standard of living increases as industrialisation takes root in third world countries, but in developed countries it falls. Today, the gap between rich and poor countries widens, as the gap between rich and poor in these countries.

The homogenisation of world is another aspect of globalisation, with the same cafes on every corner and the same signboards on buildings in almost every city and in every country (IKEA, McDonald's, Tesco and others). Undoubtedly, globalisation facilitates networking and exchange between cultures, but also tends to the reduction in cultural diversity. Interlinked global financial markets bring about local problems to international issues on the market level. Many countries participate in the ongoing technological race where a research on new solutions is coming to the fore. When the production moves to countries such as China, it gives access to new technologies. Uncritical outsourcing led to a situation that in the field of modern

technologies China is beginning to pull out the lead. In several years they may become leaders. We might of course speculate what kind of measures should be applied to determine which state is the most competitive. An attempt to answer this question was made in the article issued in FoM [9]. The authors presented a series of indicators that can be used to measure the level of innovation. There is no doubt that in order to compete in the global markets, it is necessary to be focused on innovativeness. Regardless of the criteria for pre-competitive research, China is becoming an economic power which must be taken into account even by the United States. There is no long-term vision in western countries, which allowed Chinese to take the right course. What to do to enhance the odds in the ongoing race? Before coming up with a better solution, education, flexibility and adaptability is the key for survival. So far, politicians and business leaders are only in agreement on the appreciation of the value of well-educated, flexible and adaptable employees. At the individual level, the actions may be taken on this issue, investing in higher education than the current system. Only the patents guarantee success in the technology race. The inventors will become leaders in a short time. But is it enough to win this race against countries such as China?

In my opinion, we should change our approach toward the companies’ organisational structure. For example, a mass job outsourcing in production, particularly from the United States, which began many years ago continue to flow overseas. A few years ago it seemed that only hamburgers will be produced in the United States. It was widely believed that the fate of American industry is a foregone conclusion. However, now, more and more companies, often very significant, have calculated that outsourcing did not pay off in the end. But countries like China gain in an easy and fast way to access new technologies due to outsourcing. Business, even for strategic reasons, should be conducted in their home countries, and only simple works in the production should be outsourced to cheap labour countries.

### 3.2 Social aspects of outsourcing

We should not forget about social, often painful, consequences of outsourcing. A tragic example of outsourcing to developing countries was a disaster on 24 April 2013 in Bangladesh when the Rana Plaza building collapsed outside Dhaka killing more than 1,000 workers

and a similar number were injured in the accident. It housed five garment factories, several shops and a bank employing around 3,000 people. The weight and vibration from large power generators likely contributed to the cracks appeared on exterior walls. The architect designed the five-story building planned for offices and shops. The structure was potentially not strong enough to bear the weight and vibration of heavy machineries. The owner, Sohel Rana, had built the top three floors illegally without permission and turning it into a factory. Shortly before the crash, the workers had discovered visible cracks on the walls and ran out, but the managers ordered them to return to work. A few moments later the building collapsed. More than half of the victims were women – seamstresses. Bangladesh is the world's second-leading exporter of clothing next to China. The factories manufactured apparel for brands including Phantom Apparels, Phantom Tac, Ether Tex, New Wave and German companies. It is worth noting that a shirt made in Bangladesh costs around 3 US dollars and the same shirt in the United States costs over 13 US dollars. This shows the conditions in which the workers been employed, the most vulnerable in society, and become the victims of globalisation. Some people refer to the whole situation even more bluntly, saying that they are contemporary forms of slavery. But we can also ask whether these workers consider themselves victims. For them it is the only a way of led their life, because they have no other choices. Some companies, like Zara, withdrew business from Bangladesh after this tragedy but the authorities are reluctant to that. Export earnings of textile and garments, mainly to the United States and Europe, fetched about 20 billion US dollars. It is better to give some thought to the selection of local contractors instead of total termination of business cooperation. The Bangladesh Government's agreement allows the apparel industry workers to organise themselves in trade unions without prior consent of the factory owners assuring them that there is light at the end of the tunnel. Before the crash the consent of factory owners was needed. In addition, the minimum wage is set to rise.

Next section presents a new trend in business based on insourcing.

#### 4 Insourcing – a better solution?

Insourcing is the opposite of outsourcing. Ref. [13] demonstrates the practical applications of supply chain management in today's workplace, also contains a concise definition of *insourcing*<sup>1</sup>, that is 'to begin performing in-house some activity that was formerly outsourced'. There is an equally brief definition of insourcing in the Business Dictionary<sup>2</sup>, it means 'delegating a job to someone within a company, as opposed to someone outside of the company (outsourcing).' A broader definition from the online Encyclopaedia<sup>3</sup> states that insourcing is the 'cessation by a company of contracting a business function and the commencement of performing it internally.' All definitions focus on the job assigned to someone within the company rather than someone from outside the company. It is worth considering what the reasons are.

One of the reasons for insourcing may refer to a project that has been outsourced previously will be now performed within the company. Because of the dissatisfaction, the company to reverse the decision made earlier to moving back insourcing is to assign the work to company employees to perform better. The decision to use insourcing may also arise from a desire to retain control over critical business processes or to integrate core competencies into the organisation. Another reason for insourcing might be security of employment and the avoidance of compulsory redundancies in the company by recruiting workers at risk of reduction to perform the tasks carried out so far by outsourcing. The activities carried out within the framework of insourcing can also be provided in paid form to external entities. Insourcing is also defined as transfer of productive activity and related jobs from abroad into the domestic economy (other term: *inshoring*). The reason is simply strategic with the aim to ensure control over the key business processes, reduction of taxes, reduction of unemployment or transportation costs, improving service quality and customer satisfaction, etc. Insourcing is considered to be a complex and costly method which should be implemented gradually and carefully. The choice of strategies (outsourcing or insourcing) should be preceded by, e.g. profitability analysis taking into account many factors, not just salary.

<sup>1</sup> [13], p. 546.

<sup>2</sup> <http://www.businessdictionary.com/definition/insourcing.html#ixzz2ggoHgBVr>

<sup>3</sup> Internet, Wikipedia, Category: insourcing.

It may occur that the best solution in a particular case is the choice of the third form, which includes both outsourcing and insourcing. The third way of doing business is named *co-sourcing* or *selective sourcing* and is defined by authors as ‘the sharing of a processor function between internal staff and an external provider’ in chapter 4 entitled *Strategic Sourcing for Successful Supply Chain Management* of part II of Ref. [13].

## 5 Insourcing as a new trend in many companies

Insourcing gains a higher acceptance in business. Factories, assembly plants and with them jobs start to come back mainly to America from China and other cheap labour countries. Some industry sectors again examining their position trying to assess whether outsourcing services are profitable. It is clear that one of the reasons for contracting out business process outside their country is the companies were tried to gain foot hold in the Chinese market. But when Thomas Mayor, a senior adviser of manufacturing strategy at Booz & Company<sup>4</sup> tried to find out what are the real savings, he received generally evasive answers, e.g. that the employees of the finance department were up for it but still no savings were found. Finally, John Higgins, CEO of Neutex producing low-voltage light bulbs, decided to carefully evaluate whether the production in China is really profitable. He considered all the factors that led him to move production to Asia. He took into account not only easy to count and obvious costs, such as production and transportation, but also other factors such as the ability to respond quickly to new circumstances, customer satisfaction, protection of patents, expensive but sometimes necessary travels, frequent ‘bickering’ with subcontractors and other that effect on the final result. Surprisingly, the game is not worth the candle. As a result, J. Higgins broke the contracts with subcontractors in China and despite the mixed feelings and distrust of shareholders moved the entire production to Houston in 2010. Since then he has created approximately 150 jobs and is happy with the decision. Encountered industrialists – among them competitors – were initially surprised by the decisions made by Higgins’ decision, but now they are trying to follow him [10].

Here are some examples of interest in insourcing:

- sales recruitment specialists Pareto (i.e. commercial mediation and economic consulting), based on the figures released for the final quarter of 2012, combine with preliminary numbers and projection for 2013 indicate a significant rise in uptake of the company’s insourcing services and the highest ever number of the organisational flexible recruitment solutions, which provide UK business leaders with additional sales people for the forthcoming year without the commitment to hiring long-term staff or adding to companies headcount<sup>5</sup>,
- American Federation of Government Employees (AFGE), tells lawmakers to end taxpayer subsidies to contractors, instead of that to take advantage of insourcing work to be performed by reliable and modestly paid federal employees<sup>6</sup>,
- the growing popularity of insourcing encouraged Apple Company to invest around 100 US million dollars in 2013 in domestic production. In some industries, however, can still be seen trend to overseas jobs, that is, to outsourcing<sup>7</sup>.

Deloitte [4] survey shows a growing trend of insourcing. A small but growing number of instances of companies bringing home the information technology work which in the past were carried out. Almost half, a full 48% of the respondents in the 2012 survey said that they had terminated an outsourcing contract before completion ‘for cause or convenience’. And among those who terminated the agreements midcourse, 34% chose to get the work done in-house. Deloitte said in his 2012 report that although insourcing is a small trend as compared to the global outsourcing juggernaut, given the maturity of the outsourcing industry, we are seeing more and more clients struggling with the question of whether an outsourcing deal that is not meeting expectations should be re-tendered or insourced. The survey involved 22 primary industries across 23 countries.

Most customers still prefer to fix broken deals by either renegotiations with the current contractor or re-tendering the work. Deloitte examines what is fuelling the change toward insourcing. The three main drivers

<sup>5</sup> Sales Recruitment Specialists Pareto Law Report Largest Ever Uptake of Flexible Recruitment Solutions in Company History - Yahoo! News (accessed 24 April 2013).

<sup>6</sup> AFGE Tells Lawmakers to End Taxpayer Subsidies to Contractors - Yahoo! News (accessed on 24 April 2013).

<sup>7</sup> The Highest Paying Jobs In 2013 - Yahoo! News Malaysia (accessed on 24 April 2013).

<sup>4</sup> Prestigious consulting firm, founded in the United States in 1914, offering management consulting.

are the perceived needs to improve customer service, to gain a greater control over functions that were previously outsourced, and to reduce costs. Although insourcing to reduce costs may seem counter-intuitive – given that most firms outsource in the first place to reduce expenses – companies were not always able to realise the cost benefit they expected from their outsourcing programs. If the economic gains are less than expected, then the organisation may decide to bring back some or all of the previously outsourced work to in-house. Still, insourcing can be quite a difficult challenge, even if the cause of such a change is convincing. One reason for that is the difficulty in hiring all the appropriate hands to the task requirements. The need to build internal capabilities for a job that has long been outsourced, and the potential for costs increases are also factors companies must evaluate. Deloitte emphasises that the first step to decide whether outsourcing arrangement should be insourced or re-tendered is a thorough business case based on accurate and full set of costs associated with the change.

## 6 Is the age of insourcing?

In recent years, there has been a change in the approach to the production of goods; it is noted that production in cheap labour countries does not always pay, so the companies began to re-create more jobs in their home countries. In particular, it is clearly visible in large U.S. companies. Decisions by large companies such as General Motors moving production back to home countries tend to ask a question whether the age of insourcing has already come.

Major changes in thinking about business followed with the development of the Internet. Historical and geographical social divisions are of the past. Today we are looking for people who have the Internet, no matter their place of residence. Since the birth of the Internet, we were told that the possibility of unlimited communication will foster the growth of small and agile organisations—microenterprises interconnected and using a network for contacts. Indeed, due to the Internet, economic activity between companies becomes cheaper and easier to carry out. Prospective entrepreneurs can raise funds, for example through *Kickstarter* (the world's largest funding platform for creative projects) or they may find mandatory contract work and contract workers via the Internet on *Eance* and *oDesk*, online staffing platforms. But the emergence of different types of technology and software for companies, advanced

measurement, analysis and forecasting tools brought a huge profit for Goliaths of American industry. Partially, because they maintain higher levels of business activity what increases transactional data that maybe used to develop more sophisticated credit lending models, to outsmart smaller competitors through the use of a larger number of consumer insights. In the past, a regional bank could have an advantage when lending to local companies on the basis of an intimate, thorough knowledge of the borrowers and communities. Nowadays, computer credit scoring models calibrated on the results of millions of earlier loans allow predicting better loan redemption than a man could do. But perhaps more important is the fact that the use of data will help to manage employees making these giant corporations much more efficient. Technologies facilitate the coordination of activities of employees and monitoring in real-time. As a result, managers receive up-to-date relevant information about assigned work to employed staff.

Economists George Baker and Thomas Hubbard research interests focused on the transport companies in 2004. They looked at the way of making decision whether to hire the company's truck drivers or to employ independent drivers with their own equipment and facilities. As a result, the transport company started to hire its own employees, and the reason – as it turned out – was the spread of GPS technology and monitoring. Before electronic surveillance, the companies considered it more sensible to make agreements with the owner-drivers relying on their incentives to complete the route and run their own vehicles well. At present, the employees can be supervised to a much greater extent by the use of monitoring systems than the contractors from outside the company. The technology itself can cause all employees will work more efficiently providing through real-time networks necessary information. That kind of activity is a little bit treacherous toward employees and resembles a little bit Big Brother attitude.

A group of economists from Stanford University conducted a scientific test on telecommuting at China's largest online travel agency. The researchers concluded that the experiment was so successful because the activities of workers could be easily followed minute by minute even from a far distance through the proprietary software used by the call-centre workers in the office. The researchers also found that the telecommuters were performing better but were neither happier nor

the likelihood of their dismissal was not smaller than their workmates working in the corporate boxes. The ability to coordinate and monitor more easily and at low cost events and scandals within the firms had wide repercussions. Many predicted that a better flow of information will allow the decentralisation of power, while there was more consolidation of power among executives. Professor Julie Wulf of Harvard Business School has documented the ‘flattening’ of business in the United States over the past 25 years resulted in fewer levels of management between top level and lower level management. But this is not because the decisions were pushed into lower-level managers. Simply, nowadays top-level managers are ‘closer to the business’ through communication technologies.

Reliable intuition of Nobel laureate in economics, Ronald Coase, has led to the conclusion that ‘as the companies grow larger; the cost of labour at home can get out of control’ [8]. But the emergence of new technologies has forced to a re-verification of the theory. Despite all the predictions that it would be different, it turned out that large organisation and not agile micro-enterprises benefit most from the 21st century technology.

An interest to bring jobs back home concerns most of the mega companies, such as General Motors, which in summer 2012 took the initiative to transfer 90% of their information-technology based jobs to conduct in-house. The decision was noteworthy because GM has contributed in this way to the job creation in the United States at a time when the country’s economic recovery was still anaemic and unemployment level high. General Motors is also planning to create their own payroll, limiting the transfer of work to subcontractors. Another giant who stood at the forefront of this revolution is General Electric. Complex GE in Louisville, Kentucky, is the sixth huge production buildings, each size of a large shopping centre. Plants were well-equipped, not only in production tools but also had its own power station, fire department, long parking lot with traffic lights to facilitate movement when employees arrive for shifts. GE continued to grow, employment grew up to 23 thousand people in 1973 [10]. But then came worse times for American workers. The number of employees was less than 2,000 people in 2011. Few years ago, the sale of some objects as relics of the past. But to everyone’s surprise there has been a complete change of course in 2012. The company said that outsourcing as a business is

thing of the past and started manufacturing in its old buildings, dormant for several years, which are previously manufactured in China and Mexico. The recovery of these places cost approximately 800 million US dollars but the directors believe that the spot can earn more, so it is worth to spend such a huge amount. The reasons why the factories were returned to home countries may vary. Certainly it is not about the manifestation of economic patriotism. It is true, for example, a label ‘Made in USA; is of great importance for Americans but not as much as to overpay for products manufactured in the country. Many businesses operating in China worry about quality issues in manufacturing their products over there and are moving back from China. Others, producing technologically advanced products, claimed the patent protection. Farouk Company might be a good example producing modern hair dryers. To protect against unfair competitors they moved the entire production from China, South Africa and Korea to Houston (Texas).

Raymond Vernon, an economist at Harvard University, has developed in the 1960s the product life cycle theory which worked well for the last 20 years in our consumer world. He believed that the United States will have an advantage over other countries because as a wealthy and technologically advanced country they will be able to produce constantly new high-quality products. To ensure the most effective work, everyone involved in the creation of new products from the engineers, marketers to the workers should work closely together in order to improve quickly projects and to streamline the production process if needed. They should also maintain contacts with consumers, because it allows a quick response to their needs and requirements. Vernon noted that when the market is growing and the product becomes standard; its production is spreading to other countries and raises the competition. A further step is to shift production from wealthy countries to those with low wages. When the manufacturing method is no longer a secret when manufactured elsewhere, for example in China or Korea, because in a competitive environment it is essential to cut costs. It was estimated that even in 2000 an average wage of an American worker was enough to employ 20 or even 30 Chinese workers. The world is rushing faster and faster, we are dealing with a high rate of development of Information and Communication Technologies (ICT) and increasing trade liberalisation. These factors meant that many companies moved straight to the last phase of the Vernon cycle, designing

and marketing in the home country, but often the product goes into full production to a very remote corner of the world. This way of globalised production affected alarmingly diminished jobs in factories in the first decade of this century. It seemed that nothing could stop the process, but recent decisions made by giants such as GM, GE and many other companies may give rise to optimism, at least to the American people. The aforementioned GE, still in the end of the first decade of this century, has designed innovative 'filled' with electronic devices and because of savings moved their production to other countries. This, however, carried the risk of copying their modern technologies, for example by the Chinese. Therefore, it was decided to estimate taking into account current trends in the global economy, whether it brings profit to use outsourcing. Various factors were taken into account. The replacement of a coal by shale gas on a large scale significantly reduced the cost of power consuming factories in the United States. It was also noted that oil prices are on average three times higher than in 2000, which significantly increases the cost of ocean transport. The increase of wages in countries where the production was located leads to lower profits. Wage levels in China has increased five-fold since 2000 and it is estimated that it will continue to grow by about 18% per year. The productivity in the United States grows that labour costs are still the declining proportion of full manufacturing costs. Because of the global crisis, the unions at General Electric have agreed to a two-tier wage structure and currently 70% of employees receive nearly 8 dollars per hour less than in 2005 [10]. These factors taken into account in the GE calculations are fairly universal and most can be used by other companies, especially American ones. There are other reasons why to turn to insourcing services. For example GE board of directors complained about the lack of any communication with the people working on assembly lines in China. Therefore, they returned to the Vernon theory and hire a team of people working closely together from designers, marketers to the workers. Because everyone could watch the whole process of development and production, it raised some ideas to improve the work and as a result it led to a drastic reduction in time for equipment installation from 10 h in China to 2 h in Louisville. As an example, insourcing is profitable, may be GeoSpring water heater, GE's innovative product, whose production was moved from China which brought a decrease of material costs

and work amount, and increased quality. Even its energy efficiency was improved. As a result, the company reduced the GeoSpring price by almost 20%. There was also a significant reduction in delivery time. So far, the delivery from the factory to stores took up to 5 weeks. Currently, the device goes from factories to the warehouse at the back of the plant where might be taken straight to the shops. This example may serves as a model for other companies those believe that the design phase is the most important factor enabling them to hire a cheap factory anywhere – if only of validated quality – and then the language which workers speak does not matter. It is worth noting that technological development over the years amplifies the quality of products and if the sole purpose is the pursuit of the reduction of labour costs, it will create a gap between the designers of new equipment and the workers who make them. The enthusiasm for cheaper production can also easily overlook a gradual loss of their skills, gradual homogenisation of products, decline in the quality and lack of innovation. Harry Moser, founder of the Reshoring Initiative, assisting companies to more accurately assess their total cost of off shoring believes that 60% of businesses that use foreign factories has wrongly calculated costs. They looked at the rates of the workers and forgot about the hidden costs. Moser estimates that one quarter of what is produced outside the United States can be produced more profitably in the country. In general, it is assumed that production will go smoothly. Meanwhile, there are many obstacles: the goods may be damaged in the containers or does not meet the standards, or their shortage will slow down a quick realisation of a lucrative contract to avoid falling asleep behind the competition. Then the solution is to hire airlift to quickly deliver the goods, but in this situation it is difficult to talk about savings. Nevertheless, such action shall be taken not to lose the customer. The GE and GM example is followed by other companies bringing production back to the country. Otis elevators production comes to South Carolina, Whirlpool will produce blenders in Ohio, Wham-O moved out from China and is going to make a Frisbee in California. This could mean the beginning of industrial production renaissance. The aforementioned Lou Lenz from GE also draws attention to the decreasing length of the product life cycle, giving the example of refrigerators, which, until recently, the new model could keep the market up to 7 years and now at most 3 years.

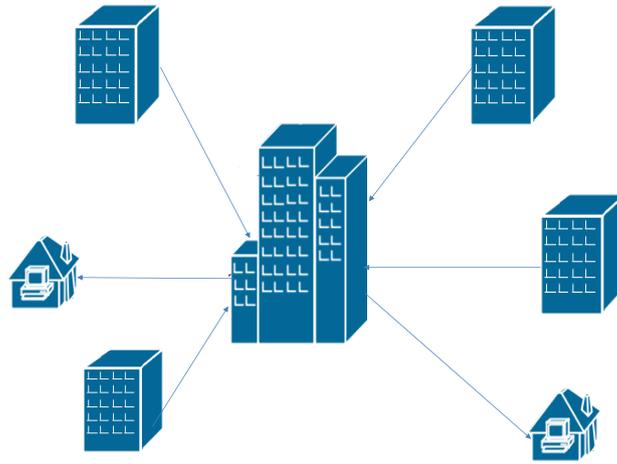


Figure 2. Insourcing of partial outsourcing  
(source: own elaboration)

This new phenomenon of acceleration production cycles is an additional reason for placing the plant in the home country, as it gives a competitive advantage. It is possible to mention more factors for insourcing.

Today, even in production of everyday objects are used high and latest technologies and this increases the attractiveness of locating plants in the country, as manufacturers have more patents to protect and workers with higher qualifications from developed countries than their Chinese counterparts. Short time between successive generations of the product enforces good communication and cooperation between different categories of employees from designers to workers. GE managers declare that factory should be a sort of laboratory in which research and development at the time of production can be worth a lot more than the savings on the cheap day's work in a rented assembly plant somewhere. The GE Appliance Park has seen big changes; during 2012 the number of employees in production has nearly doubled compared to the previous year. The company employed a few hundred designers and engineers. The company predicts that 75% of revenue from household appliances by the end of 2014 will deliver US-made products. It is estimated that the recovery in the property market will result in sales increase of such products. However, the initiated economic recovery process is not merely turning away of the existing trend of moving production abroad. Managers are making it cautiously because certain outsourcing situations are still advantageous for both sides. If the company uses, e.g. the sewing production on a massive scale somewhere in Bangladesh, it is not

necessary to employ eminent specialists for this job and the production might be performed there. This situation illustrates Figure 2, where the smallest buildings symbolise the simple works not requiring special skills.

It is worth noting that the advantage of automation improves productivity and the rate of employment in the industry in comparison with the peak level of the 1960s and 1970s is never to come back. Insourcing does not solve all problems, but it will simplify transportation, enable transparency in cost management and allows more efficient movement in a competitive market.

## 7 Full participation in management

If a company is located in the home country the most important requirement should be the improvement in the process of management system. Workers participation in all spheres of work management increases labour efficiency. In conventional management the decision making is the domain of managers, but it would be better to expand it on competent workers. Identifying employee competencies can contribute to improved organisational performance. It turns out that the secret to business success of many companies necessarily depends on the latest technologies which use mainly IT companies, like Microsoft or Google. Success can also be achieved if more attention will be paid not to products but to the people who make them. This philosophy is applied primarily in private enterprises, companies with employee share ownership and *non-profit* organisations. The success of such

an approach in management is achieved due to the high involvement of employees in organisation activity as if the company was owned by each of them. In such organisations, employees participate in the management and company's financial results. This in turn makes the staff very strongly identified with the organisation and become extremely innovative. This phenomenon is called Open-Book Management (OBM) or culture of ownership. Jack Stack and Bo Burlingham in the book devoted to the process of introducing management based on transparency [11] provide examples of highly successful companies in the world, in which the ownership of culture emerged. Southwest Airlines – low cost airline – is a conspicuous example of staff retrenchment which did not have to cut jobs after the terrorist attacks on the World Trade Center September 11, 2001. Pioneers of the new approach might be found in almost every industry: *Whole Food Market* – a network of organic shops, *Herman Miller* furniture industry, or *Harley-Davidson* in the automotive world. The secret is the use of culture of ownership in these companies which allows them to reach the most untapped resources in traditional business, namely enthusiasm, intelligence and creativity of working people everywhere and at every position. Building a culture of ownership is primarily promoted by Jack Stack, long-time president of *SRC Holdings Corporation*, where he had the opportunity to put into practice a new approach to the management of the company. This has brought tangible results, the company initially employed 119 workers involved in the regeneration of diesel engines, and today *SRC Holdings Corporation* employs more than 1,200 people in nearly 20 companies. Lasting success, however, requires constant innovations. Stack noted that the process of building a culture of ownership is not just paying bonuses or the establishment of employee share purchase options. In the successful culture of ownership, each employee must have seen the fate of the company as if he were the only owner. Achieving this level of involvement was extremely difficult, but Stack realised that the reward will be huge – a company will be able to consistently stay ahead of the market. Stack draws from his own successes and failures in the *SRC* to show how any company can teach its employees to think and act like owners, how to implement an effective program for the exchange of capital and promote continuous learning at every level of the organisation, how to encourage employees to seek competitive solutions, how to extend the concept of leadership and delegate responsibility

for operations and how to build a workforce that will be promptly ready to use every possible opportunity. Jack Stack, pioneer of *Open-Book Management*, who is also the founder of the consulting firm *The Great Game of Business* and author of the best-selling book of the same name lays out an entirely different way of running a company, a revolutionary approach to management. He introduces to the managers and executives – both large and small companies, a new way of running a business that created unprecedented profit and employee engagement. Participation in management may be partial or total. The concept of full participation has long been known – it was introduced by Graham and Titus [2] already in the 1970s. The policy of full participation in management is closely characterised by R. Stocki, P. Prokopovich and G. Zmudain and their book dedicated to this issue [12]. They explain that ‘the uniqueness of the approach of Total Participation Management (TPM) is based on the fact that participation in it is not seen as an option, but as a definitional feature of man, and therefore includes not only managers, but all, without exception, employees’. And further: ‘(...) managers who apply the full participation differ from others in their individual assumptions about other people. These seemingly simple assumptions have major implications for business.’ [12, p. 25].

In my opinion, this new face of business has a chance of success, if the selected team of employees will feel a bond with the workplace, will be not treated objectively, and regardless to the occupied position in the organisation will be treated as partners, not mere mercenaries. Such an approach encourages employees to discuss and seek new and better solutions. The worst is when under the employee guise of submission and obedience hides hatred and contempt for managers. This can lead to large rotations and achieving bad results in the company.

## 8 Industrial renaissance and ecology

The world needs more and more energy. Experts estimate that by 2035 the consumption might increase by one-third, mostly in developing countries such as India and China. Fortunately, at least for the United States, technological progress is opening up new possibilities to extract unconventional fossil fuels and light tight oil. Poland also hopes for the extraction of shale gas in the country which will allow reducing its dependence on imported gas from Russia. The International Energy Agency (IEA) predicts that by the end

of the decade the United States will be the largest producer of oil, and by 2030 it will become the exporter<sup>8</sup>, and this may contribute to the recovery the U.S. economy. Unfortunately, there are also disadvantages, namely environmental problems. Bigger extraction of fossil fuels will lead to increase in greenhouse gas emissions (although not as big as coal combustion). Abundance of fuels will cause a reluctance to seek and develop alternative energy sources. As a result the stopping of greenhouse effect becomes less and less realistic. Shale gas extraction could also cause earthquakes. Scientists suspect that hydraulic fracturing fluid injected deep into the ground at a high pressure is a catalyst for releasing inherent stresses within the tectonic system and facilitates the mass movement of rock. It was found that in the first decade of the 21st century, the observed seismic events at the fracking locations in the United States has increased even tenfold. Most of the quakes are too small to feel but there are also larger earthquakes that damage homes. There is evidence that another danger comes from the industrial wastewater being pumped to facilitate the underground fracturing process that releases natural gas. Locals complain that the ground water they drinking is contaminated with either gas or chemicals. These facts clearly show that the coal-to-gas switching causes the reduction of green house carbon dioxide emissions but results in other considerable risks.

In Poland we have only 51 exploration wells and the process of further exploration of shale gas may be postponed by a recent decision of the European Parliament. On 9 October 2013 the European Parliament adopted (by a narrow majority: 332 votes in favour, 311 against and 14 abstentions)<sup>9</sup> stringent environmental regulations for shale gas. These regulations have a request for a mandatory environmental impact assessment to be observed adequately: already at the initial stage of gas exploration, and not – as now – only at the stage of exploitation. In fact, it remains to be seen whether the European Parliament's request will be accepted by the Council of the European Union in the further proceedings but the controversies are huge.

Some countries, Poland and the United Kingdom, opposed restrictions believing that the exiting applicable environmental regulations are sufficient. The modification proposal of the European Parliament would result

in unnecessary prolongation of work and necessary increase in shale drilling expenditures which may result in disinterest of potential investors. Poland has high expectations for the extraction of shale gas on a large scale and this restrictive directive is particularly painful for us.

## 9 Doing business in Poland

There is a great diversity of conducting business activities in Poland. We have businessmen, mainly top ranked by the Polish edition of Forbes magazine who invest in Poland as well as in abroad. To reduce production costs they often choose countries in Eastern Europe. For example, Leszek Czarnecki (ranked #4 on the Forbes 2013 List) is a businessman from Wrocław, main shareholder and/or co-founder of several financial companies in Poland but also in the countries of former Soviet Union. He is associated primarily with banks: Getin Noble Bank, Idea Bank, Idea Bank Ukraine, Sombel bank (Belarus), Idea Bank (Russia), but also including insurance, leasing, brokerage, real estate (LC Corp.) and other financial companies, for example, MW Trade. Many of these companies operate in Poland, providing employment for our citizens.

Another businessman interested in Eastern Europe is Jerzy Starak, ranked #6 on the Forbes 2013 List (year before ranked #5). There are two industries in the range of his interests: pharmacy and food industry. Polpharma is a core of the pharmaceutical empire of Jerzy Starak, the largest producer of medicines in Poland and a key competitor in Russian and Kazakh market.

Polish symbol of success in the automotive industry are Solange and Krzysztof Olszewski (ranked #18/19 on the Forbes 2013 List), the founders and owners of Solaris Bus & Coach, a major European manufacturer of bus, trolley bus and tram manufacturer based in Bolechowo near Poznań. Vehicles produced here are exported to 26 countries.

It is also worth noting that the success of Bogusław Cupiał ranked #9 on the Forbes 2013 List – the founder and owner of Tele-Fonika (plant in Myślenice), the third wire and cable manufacturer in Europe.

It should be mentioned that there are many other businessmen investing primarily in Eastern Europe, for example, Marek Piechocki (ranked #13/14 on the Forbes List), involved in the clothing industry, associated with such companies as House or Reserved. Until now there are over 97 stores outside Poland with a total

<sup>8</sup> *Nowy szok naftowy*. Polityka, No. 47, 2012, p. 7.

<sup>9</sup> *Wiercenia w łupkach pójdą wolniej*. Rzeczpospolita, 10 October 2013, p. B2.

shopping area of 90,000 m<sup>2</sup>. The reserved brand was also launched in Lithuania, Latvia, Ukraine, Russia, Czech Republic, Slovakia, Romania, Bulgaria and Hungary.

The best abilities to operate in an international context must be ascribed to Jan Kulczyk who is specializing in international investments, according to Forbes Magazine, he is the richest citizen of Poland. The investor, entrepreneur, owner of Kulczyk Holding and Kulczyk Investments, operates on four continents: Europe, Asia, South America and Africa. 70% of its assets are invested outside Poland. It encourages others to invest particularly in Africa and believes that this is a chance for Polish sectors, like mining or energy, although this is not an easy area to do business. He is involved in four strategic sectors: mineral resources, energy, infrastructure and real estate. He also has stakes in London Stock Exchange listed oil and gas exploration company Ophir Energy, with a predominantly African portfolio. Kulczyk Investments is seen among the best-known and top-rated commodity trading companies in the world. As an international investment house, Kulczyk Investments has invested in a wide range of sectors and industries establishing new enterprises.

At the other extreme are Polish small businesses, which often cannot cope with foreign competition and declare bankruptcy. This is clearly an example of the food industry. The omnipresence of foreign supermarkets selling products for lower prices often eliminates small Polish retailers. At the same time a call for repolonisation of Polish economy becomes more fashionable. Such a policy does not allow foreign investors to take over Polish companies (sometimes hostile takeover). A classic case is Grupa Azoty when the State action and pro-Polish attitude of the other shareholders were unwilling to agree to a takeover of the company by a Russian investor. Another example is the Bogdanka coal mine supposed to take over by the Czech investor NWR, however, the State Treasury in cooperation with the OFE funds controlled the purchase and sale of Bogdanka controlling interest, prevented the acquisition of the mine.

At the beginning of this section, examples presented show how many of Polish entrepreneurs is seeking to invest abroad. We might ask a question whether foreign businessmen are interested in investing in Poland. We always hear complaints about the complex and lengthy procedures discouraging potential investors. Maybe not a very big interest in our country stems

from insourcing. A good example would be the production of Italian cars in Poland, which has more than 90 year's history. Fiat automobiles have been made in Poland since 1921 by a newly created Polish-Italian company Polski Fiat. Ten years later they started the production of the first Polish car branded as the 508 Balilla, and then Fiat 518 Ardita, trucks 618 and 621 and the Fiat 500 and 1500 Topolino in 1937. The outbreak of World War II and later the Cold War interrupted connections of the Polish automobile industry with Fiat for many years. Turning point in the history of Fiat in Poland was May 28, 1992, when a contract was signed for the formation of the Fiat Auto Poland located in Bielsko-Biala. The company continued the production of the brand Polski Fiat 126p. All Fiats of the last limited *Happy End* series were yellow and the last one left the factory on 22 September 2000 with the unit number 3 318 674. Since then the factory in Tychy started producing Cinquecento, Uno (1994), Siena and Palio Weekend (1997), Seicento (1998), Panda (2003), and a new Fiat 500 (2007) models to expand later the range of vehicles manufactured in Poland by a new Lancia Ypsilon (2011). Currently, Fiat Auto Poland is the largest manufacturer (6 million cars from the beginning, including production of the FSM – more than 9 million produced) and a leading exporter in Poland (more than 4 million cars). Fiat Panda had been the most popular model of the factory in Tychy, the largest factory of Fiat in Europe in 2009 and second in the world after the Brazilian factory in Betim. In spite of this fact the company has decided to end production and moved to the factory in Pomigliano d'Arco near Naples in exchange for manufactured Lancia Ypsilon model so far in Termini Imerese, Sicily. In mid-2011, the Tychy plant started production of the Lancia Ypsilon II. In December 2012, the plant informed of the necessity of workforce reduction of about 1,500 employees, curtailment of production, and the end of Panda model production [6]. Italy was severely hit by the global economic crisis which confronted it with supporting big firms. Like many American companies, the Italians preferred to employ their countrymen. Unfortunately, the reduction of workforce had deep impact on our employees.

## 10 Polish approach to reindustrialisation

Experts believe that we are in the initial phase of reindustrialisation, but in countries such as the United States comply with the requirements of industrial de-

velopment at home. Harold L. Sirkin of the Boston Consulting Group found out that in the coming years jobs are expected to rise from 700 thousand to 1.3 million in the United States industry and added 10 million jobs by the end of the decade. As many as 48% heads of companies with revenues exceeding 10 billion US dollars are considering moving some production back to the United States [10].

The U.S. economy is competitive for many reasons. For example, the labour productivity is higher than in the EU, which permits cheaper production. The massive exploitation of shale gas in the United States reduces energy costs. The Americans – women and men – agree to work up to age 66 and a short annual leave. It seems that it is easier to develop a new industry there.

The question is how other countries and Poland will cope with the changing situation in the world and in the face of economic expansion of China. The transatlantic Free Trade Zone may offer hope to the negotiations between the European Union and the United States. A free-trade agreement with the United States is economically and geopolitically crucial to the EU. It should be borne in mind that each country primarily is guarding their interests and Poland must take it into account. Poland should acquire investments that would introduce our country into a European network of manufacturers. So far, our export is not impressive to the United States, stood only at 3.7 billion US dollars, but we should advertise our food products which are enjoying growing popularity among international consumers.

Is it possible to affirm that Poland meets all the requirements for industrial development? The situation is not encouraging, since there has been a sharp increase in bankruptcies in the recent years. The vast majority of the closed plants are small and medium-sized companies what is not surprising if we take into account the structure of our industry.

Even worse, the upward tendency in closing businesses could be observed in the first half of 2013. Export Credit Insurance Corporation (KUKI) reported that only in June 2013, 85 companies declared bankruptcy, by 41.7% more than in May of this year and by 25% more than in June 2012. According to KUKI's forecasts throughout 2013 the number of bankrupt companies might have exceeded 1,150, the rate of closed businesses rose 31.9% more than in 2012<sup>10</sup>. Fortunately,

ly, the dynamics of the bankruptcy falls – according to new estimates 960 operators is to declare bankruptcy this year<sup>11</sup>. The construction industry reported the greatest intensity of bankruptcy. The entrepreneurs' hopes of improvement are raised in EU funds for the 2014–2020 period and in the Apartment for Young Program.

Central Statistical Office (*Główny Urząd Statystyczny - GUS*) studies show that the busiest people in Poland are private entrepreneurs. Often, they are afraid that if even they take a short lease something might happen in a company. It is worth to keep in mind that we do not have such a long tradition of running our own businesses such as residents of the United States. People who are descendants of entrepreneurs do not have so many fears, are more likely to invest in new ideas, and are not afraid to take risks. With the support of the family learn how to negotiate, execute and manage business expectations. It is more difficult to those who are businessmen in the first generation and those there are probably more. They had better to gain experiences working for another company. If the company owner happens to be a gracious mentor who supports and introduces the ins and outs of the business, you will think about starting your own business.

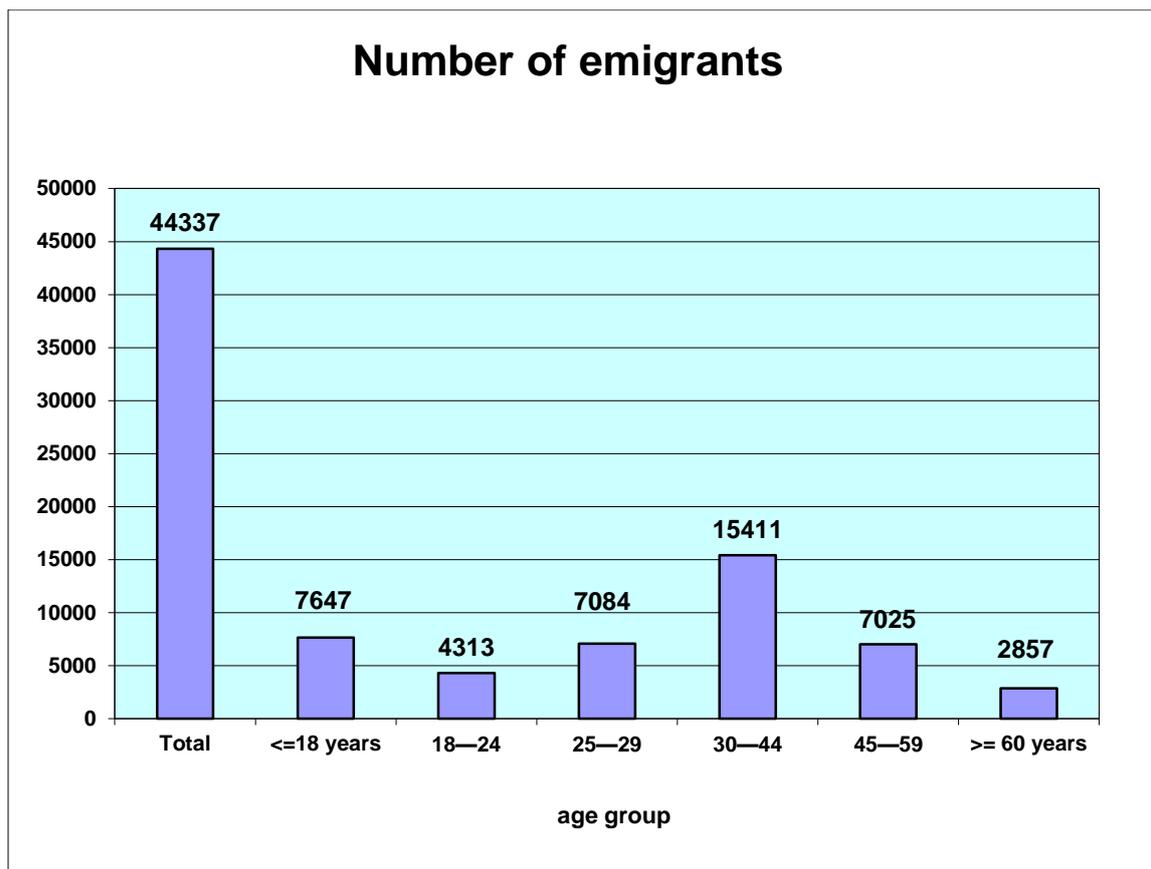
Shutdown results in high unemployment in Poland at the level of several percent and migration abroad. Central Statistical Office data collected during the National Census in 2011 show that nearly 2.02 million of Poles stayed abroad for at least 3 months. Mostly young people, better educated and speaking foreign languages go abroad. Data show that 19.0% of immigrants were aged 25–29, compared with a rate of 17.0% aged 30–34. Older people are more afraid taking risks associated with leaving their home country. Of the immigrant group aged over 55, was only 9.0%. Sixty-five percent of all immigrants were city-born residents. In terms of gender, it was found that a little more women than men immigrated, mostly to the UK<sup>12</sup>.

According to Central Statistical Office the largest group of Poles who have migrated for 1 year or more in 2011, were rather young people aged 30–44 (see Graph 1).

<sup>10</sup> *Gospodarka. Rzeczpospolita*, 9 July 2013, p. B4.

<sup>11</sup> *Upadnie mniej firm niż przewidywano*. Puls Biznesu, 9 October 2013, p. 11.

<sup>12</sup> *Dwa miliony Polaków na emigracji*. Metro, 12 June 2013, p. 4.



Graph 1. Emigration from Poland for permanent stay by age, 12 months or more, 2011  
(source: own study based on CSO data [7])

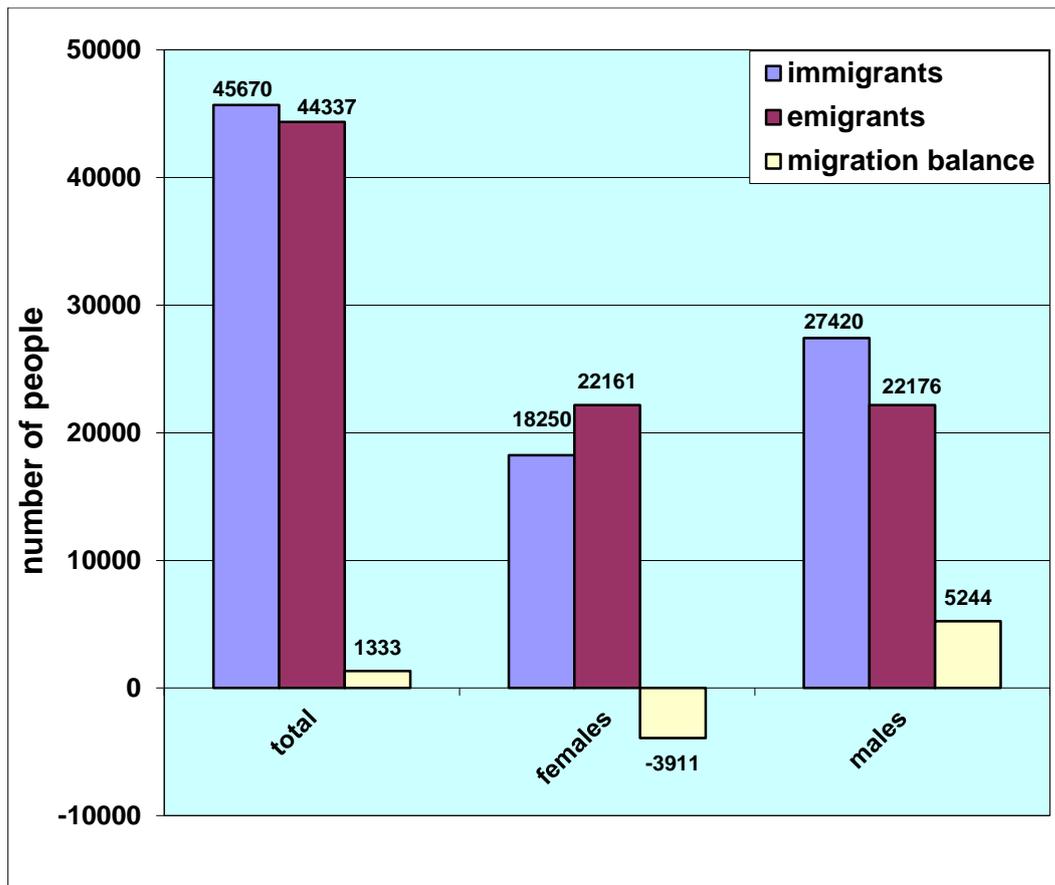
In total, in the age category 25–44, the number of emigrants is more than half of the total number of emigrants recorded in 2011. The smallest group of emigrants is older people, aged over 60. It is worth noting that in 2011 was recorded generally more immigrants than emigrants in our country. The prevailing groups of immigrants were men. In the group of women the number of emigrants exceeds the number of immigrant women (see Graph 2). The total migration balance is in favour of immigrants, so it may be assumed that Poland is perceived outside positively.

Such a positive image of our country has been pictured by Ruchir Sharma in his book<sup>13</sup>, head of the developing countries at JP Morgan, a global financial empire with assets of two and a half trillion dollars. Ruchir Sharma notes that Poland had better rates during the crisis than other countries of the region because it has not adopted the Euro; more efficient use of European Union subsidies than, e.g. in Romania, and a large internal market which allows overcoming the effects of the global

slowdown. According to the author, pragmatic Poland is located in the most promising region of Europe and together with the Czech Republic creates a ‘sweet spot’, the promised land of our part of the world [5].

It is very encouraging the our image abroad is considered positively, while here in Poland we have to cope with the long-lasting 10.0% unemployment rate caused by the closing of many companies, which in turn results in large-scale emigration of mostly young people. Ministry of Labour reported on October 7, 2013, that more than 2 million people are still unemployed (2,082). Unemployment rate at the end of September as in August 2013 was 13.0%. At the same time we faced an alarming low birth rate leading to the depopulation of the country. These facts do not offer too many reasons for great optimism when it comes to the development of business at home. Young people struggling to find a fair paid job, led the government to seek solutions to solve this problem. Package of changes in the amendment of Act employment were offered.

<sup>13</sup> Sharma R. Breakout Nations/PAP/ITAR-TASS/Shemetov Maxim /*Jak cię widzę, tak cię piszę*.



Graph 2. Net migration for permanent stay by gender, twelve months or more, 2011  
(source: own study based on CSO data [7])

The proposals include: more than 70 thousand zloty loans to start a business, the exemption of companies employing young people with contributions to the Labour Fund, financing of examinations and training loans. The future will tell whether this will contribute to the repolonisation of economy.

Potential businessmen, despite incentives from the government, are cautious when making decisions about their own businesses. The emergence of many new companies in Poland probably would lead some immigrants who have migrated for business purposes, to return to the country, but the future entrepreneurs have to calculate well, if they will find buyers for their goods or services. And this is the era of the global crisis and it is not easy. Therefore, any initiatives of our businesses that have an effect on a large scale export of our goods are very enjoyable. We can have an example of an Ursus company, based in Lublin, which signed at the end of September 2013 a contract with the Ethiopian holding company for the supply of three thousand tractors. At the same time Ursus is trying to improve their products in order to win the competition; at the

beginning of October 2013, the company presented its youngest child – a tractor with engine power: 150 hp.

The above arguments lead to the conclusion that it would be premature notion that insourcing is an opportunity for reindustrialisation in Poland. Nevertheless, the thinking should go ahead to monitor and learn from the experiences of entrepreneurs in other countries where insourcing is already used. However, in near future, the hope for the revival of the economy is placed in the interest of foreign companies investing in Poland. Poland has a chance (it was confirmed also by Janusz Piechociński, deputy prime minister and minister of economy, in an interview with TV channel Polsat News on 4 October 2013) for two automotive mega-investments: General Motors engine plant of 1.5 billion dollars and Michelin tires of 390 million. It follows the GM's policy which do not give up entirely on outsourcing services although focuses largely on sourcing recently. GM plant producing diesel engines will be built in Tychy and provide employment for approximately 200 people. This is a very important factor for Tychy because the Polish branch of Fiat,

which has its assembly plant there, fired more than 1,400 people at the beginning of 2013.

The second major investment is located in Olsztyn. The company name is not mentioned in the ministerial agreement documents (either by Janusz Piechociński in the aforementioned interview) but it will probably be the Michelin company, which has already invested 500 million Euro in a tire factory in Olsztyn. Here, the company intends to spend 390 million Euro more and employ 51 people<sup>14</sup>.

At the beginning of October 2013 good news reached Poland, this time about Amazon.com planned to invest in Poland. Amazon.com is an American international company with headquarters in Seattle, United States. It is the world's largest online retailer and one of the pioneers of this business. Amazon.com started as an online bookstore, but soon diversified, and is now one of the largest online trading companies. Tim Collins, director of Amazon's European operations, announced that Amazon company tends to open three distribution centres by 2015 in Poland and in three consecutive years will create 6000 permanent jobs and 9000 seasonal jobs. The company is going to move the distribution of their goods from Germany and will operate from Poland catering also for customers in Western Europe. German workers demanded a wage increase, so the Americans might expect that our employees will not have big requirements. Although, we benefit from 6000, the workers should not be exploited, and recommended strict control agreements would be the part of works of the Ministry of Work and Social Policy.

## 11 Summary

In my view, the competitiveness of companies can provide the selection of the 'golden mean', i.e. the use of co-sourcing strategy. The entrepreneurs could gradually introduce insourcing but leaving some outsourcing services. This proposal relates primarily to large companies that previously applied outsourcing but many other businessmen who have not applied outsourcing or co-sourcing yet could also count on higher profits and contribute to the development of their own country. This solution can for instance be attractive to companies that are in transition due to a merger or acquisition.

<sup>14</sup> <http://biznes.gazetaprawna.pl/artykuly/724223,fabryka-general-motors-w-polsce-amerykanie-moga-zainwestowac-1-5-mld-zlotych.html>, 'Fabryka General Motors w Polsce? Amerykanie mogą zainwestować 1,5 mld złotych' (accessed 8.08.2013).

Of course, this should be carefully calculated taking into account different aspects depending on the nature of business and not only economic factors. Cheap labour in Asian countries is still tempting, so a form of outsourcing can be used directly in production, such as the massively simple work in sewing rooms. Entrepreneur will be benefited with lower costs of production and will provide a source of income.

In contrast, a more strategic activity, the companies should keep to themselves. Work requiring the involvement of technical ideas and innovations as well as the integration of employees to feel responsible for the whole company require insourcing services. In this way the company will be able to retain control over the most important parts of a product or service, which is of great importance for its strategy. It is worth noting that insourcing can bring benefit not only to the company but also to the country because the hiring of their employees contributes to the reduction of unemployment in the home country. In addition, this is a contribution to the reindustrialisation.

Co-sourcing provides companies with the flexibility to decide in which areas you want to use outsourcing or insourcing and where, when and for how long.

On a global scale, taking into account the fact that the organisational revolution of the world is headed by giants such as General Motors and General Electric – flagships of the U.S. economy, it can be assumed that other companies will benefit from their experience and give rise to the great wave of reindustrialisation. The only question is whether it will mean the end of the global crisis. The return of factories to home countries is probably not enough to resolve the crisis in the labour market, but the use of modern management, based on the full participation of employees may contribute to the development of the economy and assist in the recovery of lost opportunities in previous years.

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## INNOVATION PROCESS PLANNING MODEL IN THE BPMN STANDARD

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**Abstract:** The aim of the article is to show the relations in the innovation process planning model. The relations argued here guarantee the stable and reliable way to achieve the result in the form of an increased competitiveness by a professionally directed development of the company. The manager needs to specify the effect while initiating the realisation of the process, has to be achieved this by the system of indirect goals. The original model proposed here shows the standard of dependence between the plans of the fragments of the innovation process which make up for achieving its final goal. The relation in the present article was shown by using the standard Business Process Model and Notation. This enabled the specification of interrelations between the decision levels at which subsequent fragments of the innovation process are planned. This gives the possibility of a better coordination of the process, reducing the time needed for the achievement of its effect. The model has been compiled on the basis of the practises followed in Polish companies. It is not, however, the reflection of these practises, but rather an idealised standard of proceedings which aims at improving the effectiveness of the management of innovations on the operational level. The model shown could be the basis of the creation of systems supporting the decision making, supporting the knowledge management or those supporting the communication in the innovation processes.

**Keywords:** innovation process, planning, model, uncertainty, knowledge creation, Business Process Model and Notation.

### 1 Introduction

For centuries, innovations have been the most effective factor for the growth and prosperity of most organisations. A number of surveys, on how companies innovate, shows that there is a broad consensus on the need to innovate, but also widespread dissatisfaction with how innovation process is carried out [46]. Innovations create new opportunities for the organisations, however they also bring high risks of failure along. Purpose of innovation process is to compete and differentiate in market place in a successful mode [5]. Despite the creative nature of innovation process, it should be managed. As Drucker [14] noted ‘innovation can be systematically managed if one knows where and how to look’. Innovation management is the invention and implementation of management practises, structures, processes which are novel and may assist business organisations to attain their goals effectively [7]. Innovations could be ‘new to the state of the art’ implies management innovation without known precedents [2] or being new to the adopting organisation, i.e. new-to-the-firm [12, 48]. At both levels of analysis, the innovation is seen as a significant departure from the past toward managerial activities and competencies that are better aligned with the competitive environment. New management practises, processes, structures and tech-

niques imply changes in, respectively, the day-to-day activities of managers as part of their job in the organisation (what managers do?), the routines governing their work (how they do it?), the organisational context in which their work is performed, and the associated techniques [18]. Birkinshaw [7] noted that ‘there are important similarities across the different forms of management innovation’. Innovation management encompasses all the key areas that need to be mastered to develop successful products and services, efficiently and continuously. The capacity of a firm to implement innovation management revolves around its success in dealing with these two main challenges: top-line growth and bottom-line efficiency [33]. Achieving innovation process aims could be reached through sets of management activities [8]:

- setting objectives relates to management activities to determine where the firm is going,
- motivating employees to management activities to get employees to agree to the set objectives,
- coordinating activities refers to the means by which managers organise and integrate activities of multiple groups or units,
- decision making is about making and communicating decisions regarding resource allocation.

This article deals with the issue of innovation process planning. Planning is one of the most important manager's function. Plans are used to set directions, to reduce uncertainty, to minimise time waste and redundancy, to establish goals or standards applied in controlling the process. Properly elaborated plans should be goal-oriented and possible to complete the task, therefore constitute the basis for efficient process realisation. Can one plan processes of creative nature? This is the dilemma in the context of innovation processes. The issue of disorder in innovation processes is often rise, especially in early phases, and uncertainty connected with goal formation [38]. It is colloquially said that innovation processes are like a journey into the unknown. However it is not a lonely journey for an innovator working in his laboratory, it is rather a complex set of actions where many people are involved from both inside and outside of an organisation. Therefore achieving the desired results requires management, thus planning. The main problem of research is to show the model of innovation process planning. It has been prepared on the basis of the research on practises used in Polish companies. The model explains the very essence of the approach, which is the gradual detailing of the plans by partitioning the innovation process into phases and activities. By this way the planning is realised on three levels in detail:

- the first, establishing the ramifications of the innovation process,
- the second, related to the phase of the innovation process which is perceived as a fragment consisting in activities leading to the accomplishment of an important stage of works of a concrete aim,
- the third, related to the activity being an element of the phase of the process of the defined aim.

The plans are hierarchically interrelated to one another in such a way that the plans of a lower level are subordinate to the plans on the higher level, that is, the phase plan is dependent on the skeletal process plan and all activities included in the phase is dependent on the phase plan. The plans on particular levels bind the top-down relations which allow for the agreement between different planning levels. There are also bottom-up relations providing the feedback that is necessary for the modification of the higher level plans when

conditions of the realisation of the process change. The plans on particular levels are formulated on different grades of management due to different meaning for the realization of the innovation process and different requirements as far as competence and information are concerned. Formulation of the aims of the fragments of the innovation process results from the knowledge which increases as the time passes. Therefore, the plans are prepared directly before a particular fragment – at different moments of the innovation process. Planning of the innovation process combines, therefore, decisions made up at different times by different entities. Therefore, it is crucial to properly identify and describe relations between the planning levels. The present article deals the problem which can be formulated in the following way – what connections in the innovation process planning model make it possible to make up decisions dictated by the gradual increase of knowledge on one hand and, on another hand, to constantly direct the model in order to realise the process. To show the standard of these relations the Business Process Model and Notation has been proposed. It is the standard developed by the Object Management Group (OMG) which provides an easily understandable notation for defining business processes. The primary goal of BPMN was to provide a notation that is readily understandable by all business users, from the business analysts who create the initial draught of the processes, the technical developers responsible for implementing the technology that will support the performance of those processes, and finally, the business people who will manage and monitor those processes [50].

The basis for the development of the innovation process planning model constituted the bibliography research as well as empirical investigation. In the following sections of the article, the fundamental elements of the theory of the management of innovations to relate the problem of innovation process planning are presented. Section 3 shows the methodology of the empirical research as well as the main conclusions. In Section 4 the core of the innovation process planning model is depicted. Section 5 shows relations between elements of the innovation process planning model using the BPMN notation. The last section contains concluding remarks on the use of the model in managing innovations.

## 2 Planning in management of the innovation process

The effective implementation of innovation has gained an increasing level of recognition as synonymous with constructing sustained competitive advantage thereby boosting organisational performance [31]. Within an ever more competitive environment, innovation proves a critical factor both for companies attempting to retain dominant positions and for raising profit levels [19, 29]. Various authors point out innovation as the only route to companies adapting to increasingly dynamic surrounding environments [20, 42].

### 2.1 Specifics of innovation processes

Activities realised in order to convert the invention into a commercial product or service, for that innovation makes the processes. It means that they proceed in a certain order following each other and also that mutually interrelated by certain changes they cause. Pavitt claims that innovation processes differ considerably between companies and that they are also directed according to the way they function which is largely dependent on the special field [41]. Nowadays it is commonly assumed that innovation processes are not structuralised to a great extent and that the models developed are only guidelines which should be flexibly adapted to a particular situation. One can find the claims that innovation processes are the antithesis to the linear activity [44]. For instance, Bujis underlines that the innovation process is a set of different, parallel, competitive and conflicting processes which take place at the same time [11]. The innovation process consists of stages which can be ordered and bound with each other with different interactions. A division of three phases is commonly assumed. These phases are: generating ideas, the development of the concept and the commercialisation [10]. Within these phases there are lots of activities that are realised. Kline and Rosenberg stress that the process of innovation should not be considered linearly in the sense that solving one problem leads to the formulation of another one. Instead, different problems are solved at the same time as a result of interaction, feedbacks and the coordination between different activities in the chain [30].

The feature which disallows the use of the methods of managing the project during the entire innovation

process is the lack of its purpose. Realising the set of mutually interrelated actions the entrepreneur aims at providing the knowledge for a particular area. However, he does not know what the final effect of the activities will be. Also, He does not know how long the process is going to last. Hence, the innovation processes are labelled as a journey into the unknown [49], without determined parameters such as cost, time and quality.

### 2.2 Knowledge management in innovation process

Creation of knowledge drives the innovation process and hence it is commonly reflected upon within this notion. Individual organisations as part of the global economy are exposed to an international environment of fierce competitiveness where survival relies on the speed of innovation. The ability to manage knowledge is becoming increasingly more crucial in today's knowledge economy and it all begins with generation of knowledge. Knowledge management is a term which relates to the systematised specification of the ramifications: communicating, intercepting, acquiring and organising both the covert and the overt knowledge. The aim is to enable all employees to use the knowledge even more effectively and efficiently and, what follows, to maximise the resources of knowledge [4]. Knowledge management encompasses creating, distributing, storing and using of knowledge. The management is used to create a collective wisdom in order to increase the flexibility and innovation of an organisation [16]. Fostering the process of knowledge creation is the first step to facilitating innovations in a company. Each participant of the innovation process is engaged in creating knowledge. According to the SECI model [40], its separate fragments spread within the team and the entire business. It forms, then, the basis for the use of knowledge as well as for the creation of new fragments of knowledge. As it is stated in Jorna [23], knowledge is a basic source of innovation, which is engaged in realisation of the innovation process and is the result of the innovation process. Knowledge management seen at the angle of the realisation of the innovation processes is to lead to the gradual increase of knowledge and being directed on realising common goals of a given business.

### 2.3 Uncertainty in innovation processes

The uncertainty exists if a given situation is unclear and complicated, when information is missing or incoherent as well as when people feel uncertain as to their own knowledge or a state of knowledge in general [9]. The most difficult case of uncertainty takes place when there is no immediate reason for cause-reaction state, the lack of conformity between interrelated parts and difficulties in identification of appropriate sources of information [17]. Such uncertainty takes place in the case of a new and totally unpredictable activity [43]. In a similar manner it is stated in Spash [45] where he talks about a strong uncertainty in a situation where one cannot predict the results of past events, but also when one cannot predict which events will result in changes in the future. Uncertainty, then, is a state of uncomfortable for managers as they do not know how to act in a given situation. Therefore, most people seem to avoid it [28]. In innovation processes there is often an impasse caused by a cycle of mutual awaiting for a decision which separate members of a team those who do not want to make. On the basis of literature review, there are eight factors creating uncertainty in the innovation process: technological uncertainty, market uncertainty, regulatory uncertainty, social and political uncertainty, acceptance and legitimacy uncertainty, managerial uncertainty, timing uncertainty and consequence uncertainty [22].

### 2.4 Planning of innovation processes

Planning is the process which sets the directions of action and makes decisions based on facts, aims and appropriately thought-over estimations. The very core of creating plans is orientation of all activities on previously assumed aims and their coordination. The aim of processes of innovation is gradually specified along with the increase of knowledge about a given notion. Because of this, by setting up the process one cannot specify the actions and their order of performance according to which they should be constrained in order to finalise the process. Because of this, one can often turn to specifying the intermediate goals, but without plans the works would proceed in a chaotic way which would, in effect, result in a worse effectiveness. The plan is the basic tool of coordination. Therefore, one must assume that without it the entrepreneur is going to expect the benefits in a longer period of time

than in the case when he/she prepares the innovation process plan.

The realisation of separate activities and the way of doing so results from effects of previously accomplished actions. It is an argument speaking for the fact that innovation process planning should be accomplished in a way that is not traditional. Using the standard approach to plan and control leads to a failure which comes from a too radical formalisation. The formalisation itself delimits creativity as well as flexibility that is necessary while reacting to the changes of the surrounding [1, 6, 35].

The processes of innovation are so complicated and dynamic that planning innovations should be made a basic element of managing for companies willing to develop in such way. Nevertheless, the features of the innovation process mentioned above are the basis of argumentation according to which planning cannot be effective [36, 37]. At the same time there is an articulated fact that even preparing the initial plan guarantees keeping the realisation direction on the right track and provides guidelines for the realisation of such a complex undertaking [32]. Moreover, as was noticed by Lonergan and Mumford [34, 39], in the case when the situations are poorly defined which are characteristic to a creative thinking, people tend to doubt and choose more reliable, familiar, less risky and less innovative solutions. From such a perspective the plan constitutes the guiding point leading to more innovative solutions than in the case if it was missing [3].

One of the main problems of each company is the allocation of resources [15]. Without planning and comparing the expectations to the strategy of a company there is a possibility of losing them in an endless process of generating ideas. To prevent this, the plan is to specify the conditions according to which the progress from the ideas generation phase to distribution and conception development phase takes place. This forms the condition for the realisation of the profit in the process of innovation [38]. Moreover, planning is an element that helps a given company to learn and hence it is one of the most important elements of the innovation process. One needs to notice that due to high risk, they often end with failures [21]. However, the extensive experience and knowledge in a given company is often cited as a benefit of such a process. The plan allows for the analysis of causes of failures and successes, which considerably enriches knowledge of a given business in a long-term perspective.

### 3 Research methodology

The aim of the research was to determine how innovation processes are planned, how managers realise this task considering the uncertainty of the aim and essential actions and resources. In order to find regularities, one has to consider innovation process management as integrity. This will require the analysis of planning examples, their evaluation, generalisation of observations and formulation of rules. Therefore the method of direct interview was chosen as the most adequate.

#### 3.1 Research project

Proper research was conducted using preliminary analysis. It was done on the basis of literature as well as on case study type analysis of different innovative projects in a medium sized IT company. Several projects of various meaning and novelty degree were analysed. During preliminary research all the observations enabled to hypothesise and formulate the direct interview questionnaire. The choice of the research attempt was imposed by the will of finding proper planning mechanisms. Thus it was decided to conduct the research in those companies which realize innovation processes and achieve satisfying effects. The companies were selected from Polish innovation ranking leaders. So as to formulate general rules, observations were made in companies of different sizes and branches. Medium-sized companies, which employed approximately 100 people, constituted the biggest percentage among those which agreed to take part in the research (~50%).

#### 3.2 Data gathering

Every interview referred to several examples of innovations conducted in the space of 2–3 years. Its aim was to compare the approach toward innovation planning regarding the character of the process. The analysed examples of innovation processes were characterised by various novelty degree, scope of changes and meaning for the enterprise. They concerned innovations of different types, however the majority related to product innovations (ca. 60%). The research was successfully conducted in 32 companies; over 100 examples of innovation processes were analysed. The examples were selected based on the evaluation of managers who were asked to discuss those processes which, in their opinion, ended successfully. The interviewers concentrated on gaining information, nevertheless also referred to other managerial functions.

The interviews lasted on average 1.5 h and were conducted with people directly managing the processes and also with board members of the enterprise. Despite preliminary assumption, not many companies possessed documentation related to innovation process planning.

#### 3.3 Research conclusions

Conducted research led to a number of conclusions which were the basis for formulating the assumptions of innovation process planning model. The most important conclusion was the fact that plans are created gradually; it enables managers to use the gradually collected knowledge. That is why the plan of the whole process is not created at its beginning. Only its realisation frames are set and within those frames and further decisions are made concerning logic fragments of the process such as stages and actions. These decisions are made directly before commencing a particular fragment. It is compliant with Du Preez's [13] statement that in order to improve the innovation management process, it is wise to break the whole process into smaller stages of activity. This helps to guide and focus on activities, especially the information generation and collection activities. A staged approach therefore simplifies the management of the innovation process by providing clear management decision points. This ensures better control of the process in terms of time and quality. Progressing task realisation leads to specification of given aims, it can be, therefore, stated that planning is dynamic. All decisions are made referring to current knowledge and forecast. It should also be noted that realisation of innovation process depends on company's resources. Competences are the most important among the resources. The use of external resources is frequent while executing particular process fragments and it is also determined by the company's possibilities. Thus managers, while making planning decisions, on the one hand consider the requirements describing the expectations toward process effects. On the other hand they take into account the possibilities describing expenses for achieving those effects. To sum up, a manager who creates and plans can only gradually analyse the situation with the progress that is with the creation of new knowledge. The lack of knowledge constraints the planning, as it is shown on Figure 1. While passing between symbolic points, one makes further decisions and clearly sees the aim.

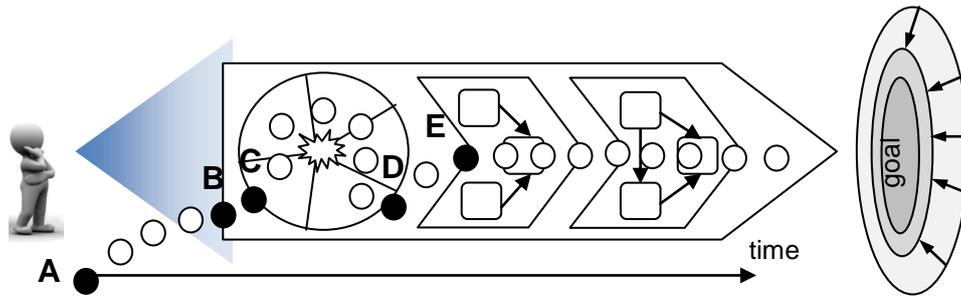


Figure 1. Option of formulating planning problems

Point A, the beginning of an innovation process, is a place where decisions are made about the limits. In point B the manager refers to the first phase of the innovation process. It is in point C that detailed decisions are made concerning actions. In the presented example it can be idea generation or opportunity identification, depending on the impulse which provoked the innovation process. Hence passing from point to point unknown number of times in an unknown sequence, particular actions of front-end phase are planned. Only after achieving the assumed result, which is being in point D, one has the accurate knowledge to elaborate plans for development phase. This phase is more structured, however, recurrences and repetitions of certain actions cannot be excluded.

#### 4 Concept of planning innovation processes

The model compiled as a result of research carried on in the previous chapter points to the components of planning the processes of innovation as well as describes the interrelations between them. It is proposed to look at the innovation process at the angle of the knowledge created, what its importance for the company is and how to plan its creation. At the moment of initiating the innovation process one cannot specify its aim and, as a result, to determine its course. Therefore, it is impossible to create the plan in its entirety. On the other hand, if one wants to follow a particular direction, to reasonably allocate resources, coordinate the works, coordinate the course of the process one needs to have a plan. Hence, the solution is to separate fragments of the innovation process and providing plans for them with compliance to decisions for the entire innovation process. It is possible only as a result of a trial and error method. From this perspective, the problem has been stated as follows: which fragments of innovation processes should be formulated in order for decisions related to them could be undertaken including the created knowledge and the changes of the

surrounding. At the same time it should be specified which structure of plans guarantees both the stimulation of the progress of works in a given direction and the coordination providing, at the same time, flexibility allowing for the introduction of creative solutions and the reaction to the results obtained.

##### 4.1 Assumptions of innovation process planning model

The innovation process is undertaken in order to obtain particular profits which are to be vital for the company's development. The development of a company can be realised by traditional and innovative solutions. The company decides to use the innovative process if they expect a better effect (e.g. more permanent or significant change). The effect of the innovation process can be a product, a process, a marketing method or an organisational method. Undertaking the innovation process, the entrepreneur estimates if he/she has an access to right resources. The company which realise innovation processes make use of internal resources and, if it is possible, external resources. Within the surroundings of the company there are constant changes whose influence has to be included in the plans of the innovation processes. In the innovation process the level of uncertainty decreases considerably along with the progress of works [47]. Therefore, there is no need of making detailed decisions ahead of time. The phases of the innovation process follow in a strict order. They are sets of activities which aim at obtaining a particular effect which is a vital point during the realisation of the innovation process. Knowledge is created during each phase and is necessary for the initiation of another phase. It is, then, vital to specify the criteria of the evaluation of the end of each phase. Activities within the framework of a given phase can take place simultaneously, in a parallel fashion.

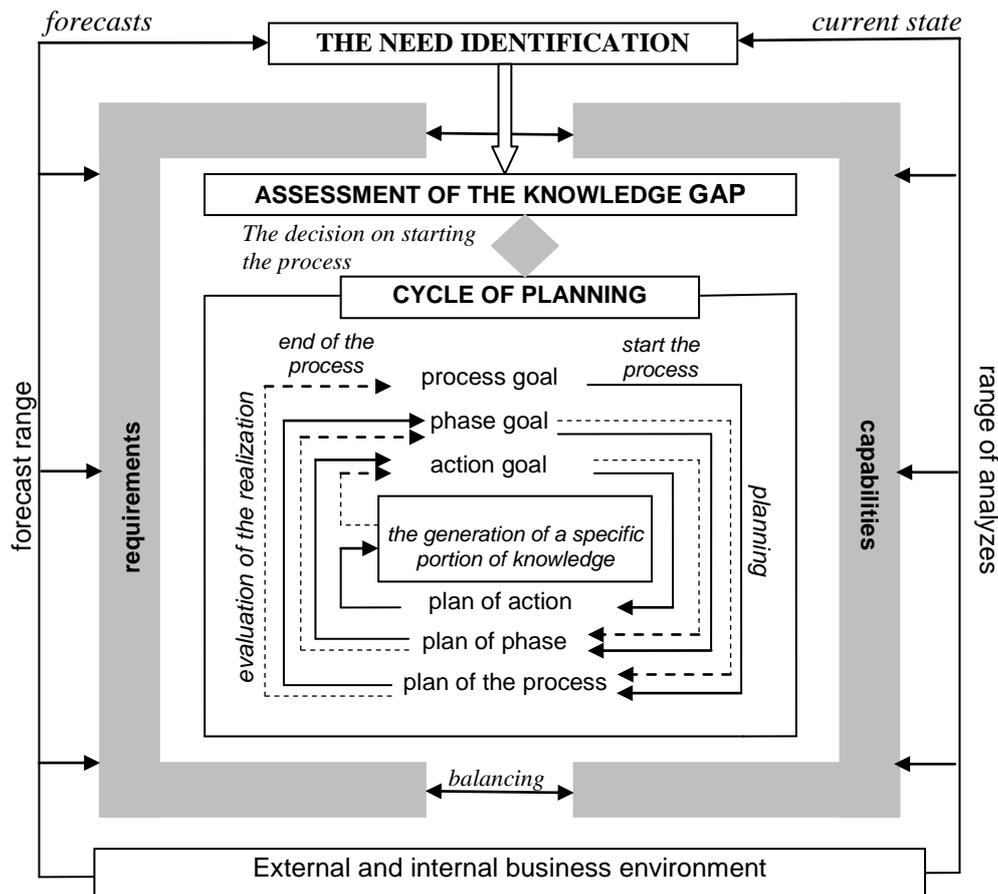


Figure 2. Scheme of the innovation process planning model

They are the set of activities which are bound by a common goal. It describes a part of knowledge which is to be created as a result of an activity. The activities in the innovation process are often experimental in nature. Therefore, the effects of their realisation are often not known in advance. The effects can determine the undertaking of subsequent, previously unpredicted works. The activities which lead to obtaining a given effect can be repeated even several times and realised in different ways. One needs to specify the criteria describing a satisfactory effect of their completion. In the case when the effects are not met the innovation process can be stopped or given up.

#### 4.2 The essence of innovation process planning model

In order to meet the presented requirements, the model assumes the sequence of the process of the plans creation. It is a gradual and successive (along with knowledge creation) transition from generally formulated plans (guidelines), to detailed planning decisions. The model specifies the dependences between subse-

quent levels of planning and shows what the basic elements of decisions that were made. Figure 2 provides the scheme of the model with the connections between plans of different fragments of the innovation process together with elements basic for the planning decisions.

The outer square symbolises the surrounding of the company. Thanks to predicting of the surrounding changes trends the needs determining the development of the company are identified. The external surrounding constitutes the requirements and the internal situation delimits the possibilities of fulfilling these requirements. The identification of the need is the impulse to consider the undertaking of a particular innovation process. The final decision about whether to develop a particular area of the company functioning in a traditional or innovative way will be constrained by the wish of the entrepreneur to take the risk and follow a different, more innovative and risky route of development.

Balancing between requirements and possibilities constitutes ramifications for the entire planning process. Not only does it determine whether the innovation

process will be initiated, but it also specifies its entire course which is the basis for formulating plans of all innovation process fragments. Specifying the current state and the requirements related to fulfilling a certain need provides the possibility of assessment of the gap in knowledge which disallows a given company from implementing the innovation. Such a diagnosis rests on subjective values expressed in the linguistic form, therefore, it has been suggested to carry it on the basis of the fuzzy logic [24]. The value obtained in this way gives the basis for an ultimate decision of whether to take up the realisation of the innovation process which will require creating and implementing a certain amount of knowledge to the company, or not.

The fragment placed at the centre of Figure 2 shows the recurrent procedure in compiling plans related to the realisation of the innovation process. It is the planning cycle which encapsulates taking planning decisions, their creation and estimation of the effects. It rests on the successive formulation of indirect goals and providing plans for their realisation. As noted above, it is only at the point of relation to actions can the goal be precisely formulated. Such a precise formulation will ensure that the plans due to their specificity can be termed as executive.

Goals and plans of the fragments of the innovation process are hierarchically interrelated in order to reach the assumed goal in a stable manner and to fulfil the identified need. It means that the skeletal plan of the process is the basis for more detailed plans of the process phases. The phases, in turn, specify the possibilities during the formulation of the plans of activities. Realising the activity allows for acquiring of knowledge necessary for planning and initiating another activity. Such a process is repeated until the end of the phase, that is, the realisation of all the activities leading to its completion. Knowledge gained as a result of the completion of a phase is the basis for the estimation of the plans of another phase within which another group of activities will be planned and realised.

## 5 Relations in innovation process planning model

In order to show the relations between levels of planning a standard BPMN was used. The notation inherits and combines elements from a number of previously proposed notations for business process modelling, including the XML Process Definition Language (XPDL) and the Activity Diagrams component of the

Unified Modelling Notation (UML). Like these predecessors, a key idea of BPMN is that process models are composed of:

- activity nodes, denoting business events or items of work performed by humans or by software applications,
- control nodes capturing the flow of control between activities.

Activity nodes and control nodes can be connected by means of a flow relation in almost arbitrary ways. Furthermore, BPMN brings additional features not traditionally associated with graph-oriented languages. These features include the ability to define:

- subprocesses that may be executed multiple times concurrently,
- subprocesses that may be interrupted as a result of exceptions,
- message flows between processes.

The modelling of business processes often starts with capturing high-level activities and then drilling down to lower levels of detail within separate diagrams. BPMN utilises the concept of pools as a mechanism to organise activities into separate visual categories in order to illustrate different functional capabilities or responsibilities. Pools are used when the diagram involves two separate business entities or participants and are physically separated in the diagram. It was used showing the planning cycle of the innovation process (see Figure 3), which is realised at three levels representing the stages of the decisions made:

- 1) Company management where general plans are formulated. These plans form the framework for the innovation process. Also, the most important decisions such as stopping the realisation of the process, cooperation with external units, etc. are made.
- 2) The level of the leader of the process where phase realisation plans are formulated as well as the decisions concerning initiation of subsequent activities are made.
- 3) The executive level where the way in which a given activity is going to be performed is specified. Also, some detailed decisions concerning its realisation such as allocation of resources, initiation moment are made at this level.

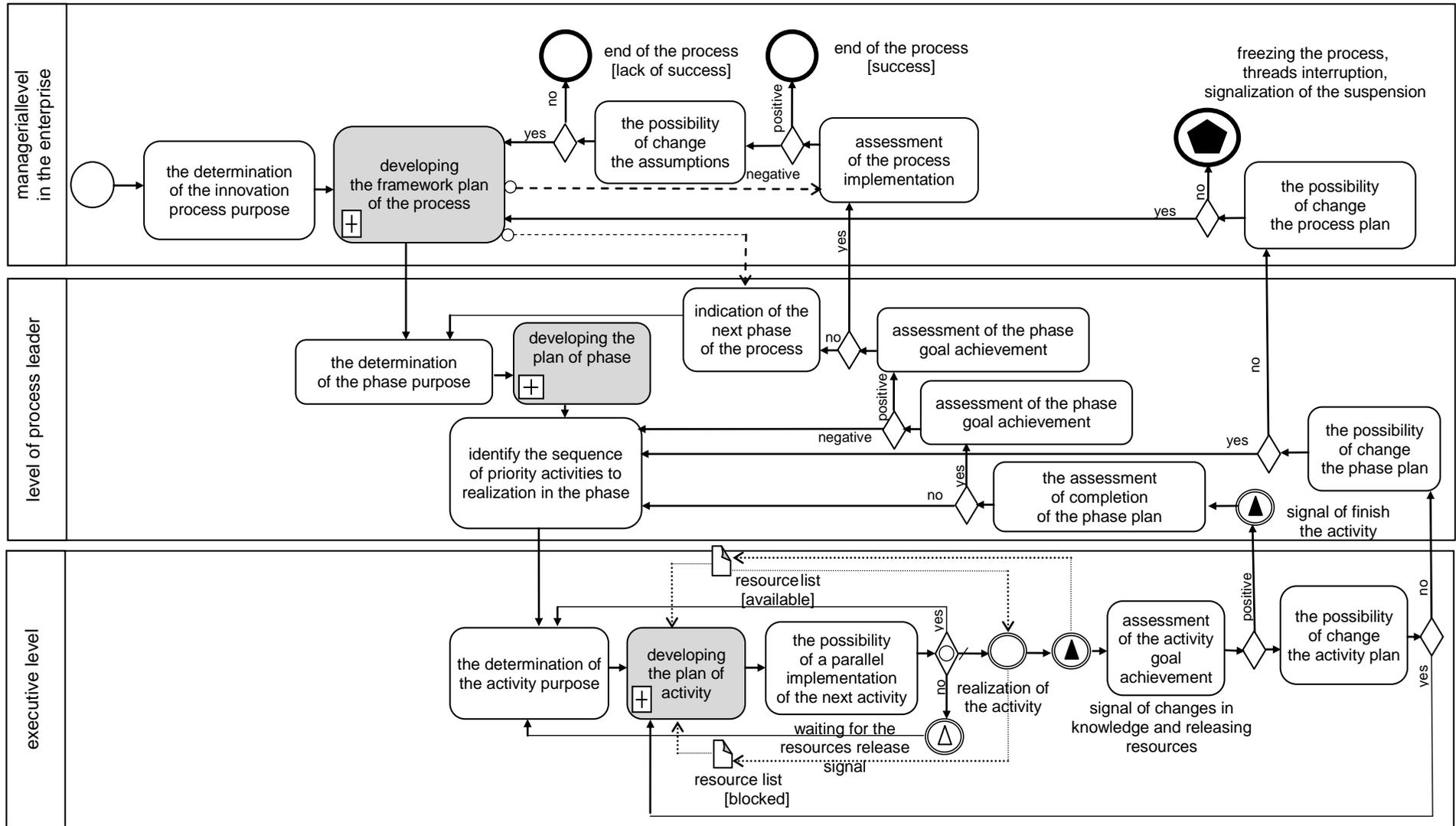


Figure 3. Interrelations between levels of innovation process planning

### 5.1 Interrelations between decisions of first level of planning

The planning process at the first level begins by providing the scheme for the innovation process. It is formulated in a general way showing innovative areas as well as effects which should be met at this area. Even due to such unspecific assumptions, it is possible to formulate the guidelines acting as frameworks for realising the process as a whole. They are, however, very general, which allows a flexible creation of plans of smaller

fragments of the process. The smaller fragments take into account the surrounding changes as well as the knowledge acquired.

Decisions made in this area are superior to the subsequent planning levels. The compilation process of these plans is marked by the block in Figure 3. Expanding it into the scheme of the planning decisions at the first level as shown in Figure 4, where the most frequently appearing sequence of decisions is depicted. It also shows the information used for its undertaking.

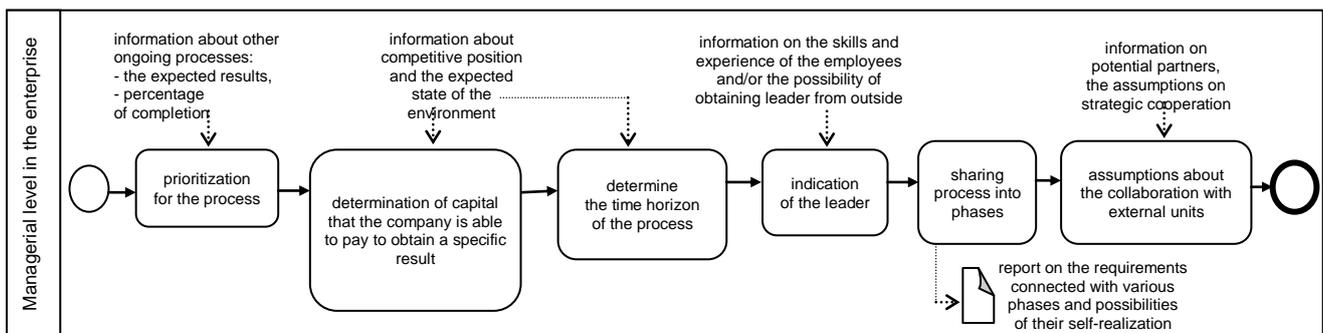


Figure 4. Compiling the framework plan of innovation process

### 5.2 Relations between decisions at second level of planning

The phase of the innovation process represents its crucial fragment leading to the completion of one stage of the process and allowing for the initiation of another. If at the first level of planning one assumed the division of a given process into three phases, the plans will have to be formulated three times at the second level. It follows immediately after defining the goal for each phase, that is, at different moments of the innovation process. The planning procedure at the second level starts from specifying the effect that the realisation of a given phase has to reach. From the planning procedure result key actions that have to be undertaken to reach this effect. Specifying the plans being directives for the phases of realisation one depicts among other things the level of the technical advancement, compatibility with solutions used, the effect on the natural environment, etc.

At the level of planning of a leader of the process one makes decisions concerning the cooperation with external units. The range of works entrusted to the external unit as well as additional arrangements (e.g. about the communication method) are being specified. On Figure 5 which shows the scheme of interrelations

at the second level of planning one included the option of such cooperation.

### 5.3 Relations between decisions at third level of planning

Phases in the process of innovation follow each other consecutively. This does not include, however, the actions included in the phase range. Due to the parallelism of realisations of actions, the planning procedure at the third level is performed dynamically. Specifying the goal of the realisation of the activity is dependent on the results of the previous actions within the framework of a given process fragment. Therefore, the plans are formulated directly before the beginning of the activity. Specifying the goal of the realisation of the activity is dependent on the results of the previous actions within the framework of a given process fragment. Therefore, the plans are formulated directly before the beginning of the activity. The problem connecting the second and third level of planning is the question from which action to begin in order to get the highest possible efficiency of the use of resources. The proceedings in this case somewhat resembles a system of 'squeezing' which is known for steering the flow of production.

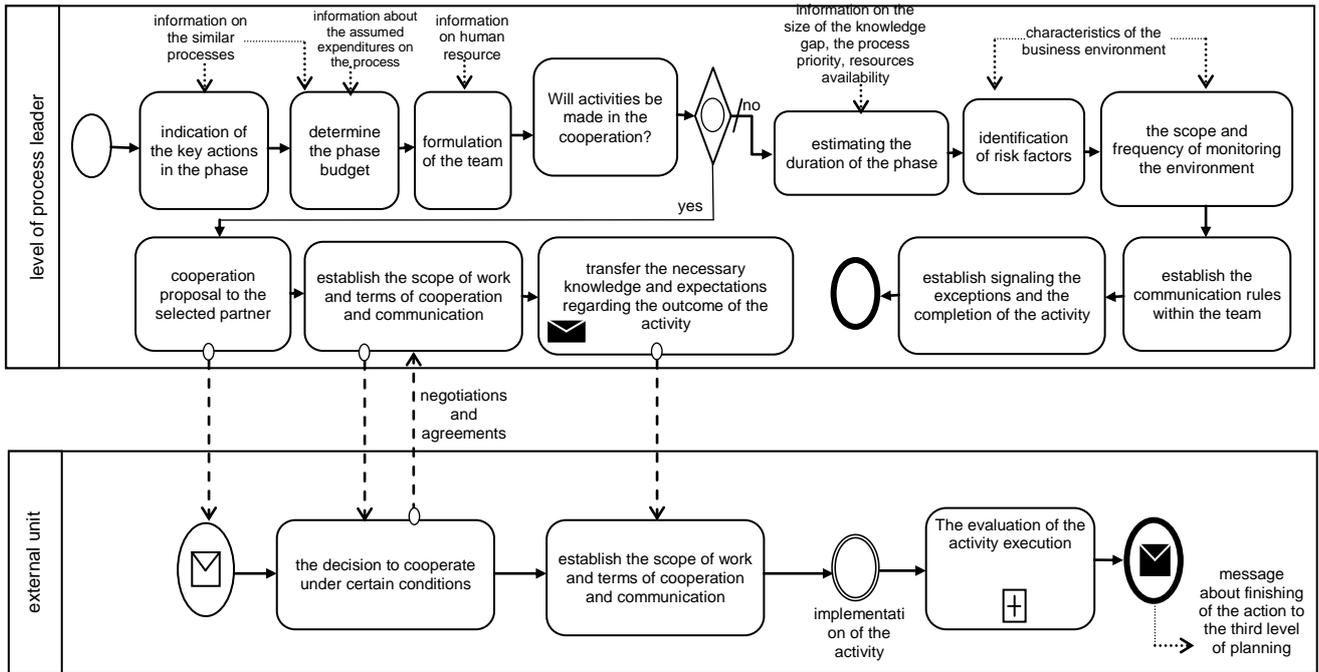


Figure 5. Relations in planning phases of innovation processes including cooperation with external units

It is suggested to start planning by indicating the sensitive fragment of knowledge that should be generated in a given phase. These can be activities associated with the highest costs, longest time or the most risky ones. They can also be those that create most unique knowledge. Such action delimits the realisation of the process from the standpoint of achieving the intended effect of the phase – its purpose. Not only do the works leading directly to the key fragment of knowledge can be undertaken immediately after initiating a given

phase. The planning procedure begins then from those which have to precede the undertaking of this crucial activity. Focusing on the chain of activities to achieve the desired outcome organises the planning procedure in the execution phase. This allows for the coordination of works and selecting those whose realisation affects the goal of the realisation of the phase and the time of its completion. The scheme of interconnections on the executive level is presented in Figure 6.

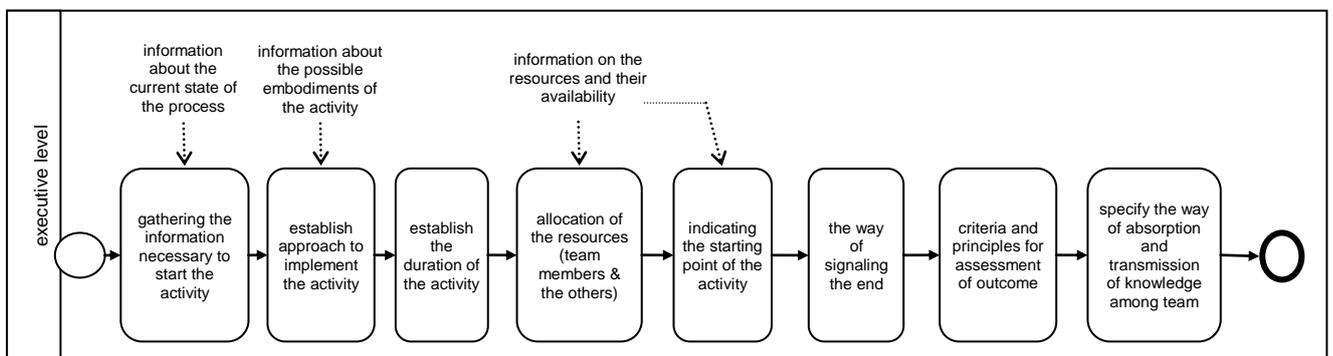


Figure 6. Interrelations between decisions at the executive level of planning

The approach presented gives a considerable freedom of the executor of the activity and allows using creative solutions. On the other hand, knowing the plan, the leader can control the course of its realisation. As was noted by one of responders such approach influences the work progress and improves the engage-

ment of the team. The ideas for reaching a given goal of the activity can be discussed in a group, which solidifies the cooperation in a team and influences the creation of knowledge.

## 6 Conclusions

The model is a simplified and idealised way of showing the phenomenon being researched. It can refer to real standards, but also to potential and ideal systems. In this case, the model of planning the innovation processes combines so to say the two approaches. Real practises functioning in companies have been generalised and idealised, therefore, creating a coherent entirety which presents the philosophy of planning the innovation processes. The important aspect of this model is the guarantee of the convergence of the successively compiled plans of the fragments of the innovation process with the need determining the development of the company. Hence, the model is a path on which the manager can move in a way that is best for him/her. Following this path the manager makes use of the experiences, thanks to which he/she can avoid particular mistakes and errors which play a major role in failures in realising the innovation processes. A general assumption differentiating the presented model from approaches such as Stage-Gate or Innovation Funnel was the concentration on the area having the influence on the development of the company. Such identified needed the ideas of innovative solutions are generated. In other publications a different approach to establish this need with respect to different management horizons [25] was presented. Also, the approach toward eliciting fragments for which the plans are formulated [27] was offered. One noted also the issue of the estimation of the capabilities for the realisation of the innovation process by a given organisation [24] as well as the approach toward the analysis allowing for the decision making on different levels of planning [26].

In this article the author focussed on the interrelations between the levels of planning which are to integrate the intermediate goals as well as decisions for their completion. The presentation of the most important relations in the BPMN standard allows for the translation of the compiled standards into practise. This is important for the preparation of the planning system in particular companies where the model is going to improve the efficiency of management of innovation processes. Preparation of the set of algorithms made it possible to also verify the model itself. The BPMN standard turned out to be clear in a way that made it possible to prepare an analysis of subsequent steps of planning without any problems even by people who

had not been previously familiarised with the modelling of processes.

The innovations are compiled and implemented with the future in mind. They result, therefore, from the estimations which are often taken to contain errors and the degree of uncertainty. It complicates the planning procedure which has to be dynamic in order to enable reactions to unpredictable notions. The question may be asked: is not using the model an oversimplification? Researching this problem one has stated that the effectiveness of managers in managing the processes of innovation is mainly the ability of an adaptive creation of plans. Thanks to a gradual planning one may obtain a significant flexibility as well as the adaptation to the changes of the surrounding as well as the successive knowledge acquisition.

In order to obtain considerable profits from using such approach the advanced abilities of self-organisation of teams are, however, required. It is the element of the innovation culture which should be developed constantly. Organisations have different capabilities in this respect and, hence, the interrelations between levels of planning shown above should have more or less formal character. Formally, the relations guarantee the effectiveness of interrelations between levels of planning. The relations between levels of planning presented in the article can be the basis for the projecting the procedures of acting in different situations. Due to the high level of uncertainty and low precision of the plans the further researches should focus on stating the mechanisms of the control and steering of innovation processes.

### Acknowledgement

The project funded by the National Science Center in the scope of the research project No. 4025/B/H03/2011/40 Fri: "Developing a model of planning and estimating the cost of innovation".

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## A MODEL OF KNOWLEDGE SHARING IN POLISH MANUFACTURING ENTERPRISES

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**Abstract:** This article elaborates on a model of knowledge sharing in Polish manufacturing enterprises. The author aims to analyse the effectiveness of knowledge sharing in Polish manufacturing enterprises based on the research results gained from the study described in this paper. In particular, the likely consequences and results of knowledge sharing by using Web 2.0 technologies are studied. This is followed by a discussion on the results of the literature and empirical studies. The summary indicates potential directions for further work.

**Keywords:** knowledge sharing, Web 2.0 technologies, effectiveness.

### 1 Introduction

The design of a business model of a company is of major importance for entrepreneurial ventures [37]. The essence of a business model is in defining the manner in which a business delivers value to customers, entices customers to pay for that value and converts those payments to profit [32]. About \$31.5 billion is lost per year by Fortune 500 companies as a result of failing to share knowledge [1]. Knowledge sharing is critical to the success of a firm in today's highly competitive environment [10]. Because of the potential benefits that can be obtained from knowledge sharing – e.g. reductions in production costs, firm innovation capabilities etc. [22]; [21] many enterprises have invested in systems and/or tools that can be used to facilitate the sharing of knowledge.

Shared knowledge, vectored mainly through IT technologies, can enhance the effectiveness of internal business processes in enterprises as compared to those processes which are carried out without these technologies. IT resources consist of a combination of technical skills and generic information [28]. Knowledge management in enterprises has evolved from traditional IS (information systems) implementations (monolithic, centralised, controlled) to implementations based on social media and collaborative sharing: Web 2.0, social media, online communities, etc. [23]. Paroutis and Al Saleh (2009) [25] show that Web 2.0 technologies, including blogging and other social media applications, have helped people to share what they considered to be knowledge in an effective and efficient way.

The value of companies has traditionally been judged on the basis of their financial assets, property or other tangible assets. Today, a competitive advantage is viewed as being based on the knowledge of workers. Intangibles such as brand names, patents, copyrights and R&D spending are now a significant part of the assets of many companies [26]. National statistics on the state of Polish manufacturing enterprises indicate that an increase in production was recorded in 19 out of 22 test subjects, the largest increases in production were in transport equipment (39.1%), metal products and furniture (18.2%). Declines were recorded in the manufacture of pharmaceutical products (12.2%), manufacture of computer, electronic and optical products (7.0%) and machinery and equipment (2.9%) [Polish Central Statistical Office, 2011].

The author discusses the issue of the tools which were used to facilitate the sharing of knowledge in Polish manufacturing enterprises in order to improve their efficiency. This article addresses the following research questions: Do Polish manufacturing companies really use Web 2.0 technologies? What is the efficiency of a company and why has it become an issue associated with the use of Web 2.0? What is the actual impact on the efficiency of Polish manufacturing companies of those Web 2.0 technologies that are actually used? Some of these issues will be illustrated based on data collected from 25 Polish manufacturing companies.

According to Etzioni [9], organisational efficiency can essentially be defined as the extent to which an organisation accomplishes its goals. Understanding the purpose of knowledge sharing in an enterprise allows for a definition of its effectiveness as consisting of the benefits that can be obtained from using Web 2.0 technologies. To achieve a more contextually rooted

discussion, this paper explores the perceptions of the potential of Web 2.0 among employees in Polish manufacturing companies. This paper also explores the influences that impact the way manufacturing companies perceive Web 2.0, and thereby how these influences may facilitate or inhibit thinking about Web 2.0 use in knowledge sharing within such companies.

The structure of this paper is as follows. The following section introduces the theoretical framework consisting of tools which are used to facilitate the sharing of knowledge and improve the efficiency of a company. The subsequent methodology section provides the details of data collection used in the study. The third section presents the measures and research methods and the fourth presents the results and findings of the analyses. The final section summarises the conclusions of the study and provides potential implications for future research.

## **2 Theoretical background and hypotheses**

### **2.1 Knowledge sharing in the manufacturing enterprises**

Knowledge sharing in manufacturing companies is not an easy task. But accurate knowledge is one of the key issues which affects the success of a business organisation [11]. Knowledge sharing is a process in which knowledge and skills are transferred from one individual to another [21]. Chaudhry [5] discovered that effective knowledge sharing practises allow individuals to reuse and regenerate knowledge at the individual and organisational level. I agree with Barson [2] that there exist individual barriers in knowledge sharing, but also with Bureš [4] who found that such barriers at the organisational level.

According to my research conducted in Polish manufacturing companies in the construction and automotive industries, 52% of respondents defined production difficulties resulting from problems in knowledge sharing within the company in the form of insufficient organisation of the company and a lack of communication between the company employees. More than 30% identify that a reluctance to share knowledge is a continuous factor in production problems. A Knowledge Management System (KMS) can effectively facilitate knowledge sharing by helping to remove some of the barriers, for instance, a lack of accessibility to organisational knowledge and physical distance between members [17].

According to Nonaka and Takeuchi [24] and to Polanyi [27], human experience is the foundation of tacit knowledge sharing. On the other hand, mechanisms such as procedure, formal language, handbooks and information technology systems will promote the willingness of employees to share their explicit knowledge [6], [13]. Zahra, Neubaum and Larrañeta [35] assumed that knowledge sharing can be done through informal, unsystematic and non-daily routines within an organisation. Tampoe [31] discovered that motivation for knowledge sharing mainly comes from personal growth, operational autonomy, task achievement and money. Tacit knowledge is basically composed of the following five elements: the technical element, the experiential element, the cognitive element, the emotional element and the faith element [20]. I believe that explicit knowledge must be supported by tacit knowledge. In this study, I will try to define the technologies that can be exploited for knowledge sharing – both tacit and explicit, that could be exploited in Polish manufacturing companies.

### **2.2 Web 2.0 technologies for knowledge sharing**

Huang, Chen, Kuo, and Jeng state [14] that most Web 2.0 websites are free and have made it easy for users to create a personal space where they can share information immediately or transmit information more rapidly than by other more conventional means. Boulos and Wheeler [3] define Web 2.0 as the ‘social web’ and Hemmi, Bayne and Land [12] as the ‘read/write web’. In order to explore the impact of Web 2.0 on increasing the efficiency of business processes in manufacturing companies, one can start by reviewing and building on the literature which examines the role of online communities in supporting knowledge sharing in companies. Erat, Desouza, Schafer-Jugel and Kurzawa [8] discussed how different types of communities of practise (e.g. B2C, C2C) can be used for acquiring and sharing knowledge in order to improve business processes and performance. On the other hand, Li and Stromberg [19] discovered that the benefits of blogs for firms are search engine optimisation; e-word-of-mouth (eWOM); improved brand perception and visibility; instantaneous client feedback; market research and insight; increased sales efficiency and a reduced impact from negative user-generated content. Web 2.0 platforms are emerging as a viable channel of knowledge building for general and discipline-specific communities [16]. Knowledge sharing

using Web 2.0 can be carried out through technologies such as VoIP, e-mail, tagging, phone/video-conferencing, blogs, wiki pages and instant messaging to support processes, including through dialogues and discussions.

### 2.3 The effectiveness of internal business processes in manufacturing companies

According to Law and Ngai [18], it can be stated that knowledge sharing is positively associated with improvements in business processes. The goal-attainment approach (one of the number of models for measuring organisational efficiency) considers organisational processes as a whole. Upton [33] stated that decisions in manufacturing companies, such as the timing and quantity of stock procured, manufactured, stored, and delivered, have a significant influence on company performance. Knowledge sharing with the exploitation of available technology will undoubtedly reduce the risk of erroneous decisions in enterprises.

Furthermore, Velasquez et al. [34] claimed that conflict could arise in manufacturing decisions due to incomplete or inaccurate information. The development of information technologies in the late 20th century and 21st centuries in many states, including Poland, changed and continues to change information flows [15] [36]. Today, as corporative information is emerging, the problems of the efficient use of information technology are clearly of paramount importance. Already Simon [29] suggested that the use of information technology can improve organisational efficiency. I agree with Syuntyurenko [30] that information technologies are the foundation of an entirely new level in the development of civilisation, the same can be said regarding their impact on business enterprises. National statistics on the information level of Polish enterprises show that they use information technologies such as Manufacturing Execution Systems (MES) – 24% of all enterprises, Customer Relationships Management (CRM) – 23%, Business Intelligence (BI/Controlling) – 18%, Business Process Management (BPM) – 4%, Supply Chain Management (SCM) – 11%, Product Lifecycle Management (PLM) – 7%.

Devaraj and Kohli [7] believed that investment in technology has been treated by the literature as a black box and its impact on business performance measured with little context. On the other hand Zhang et al. found

a positive relationship between IT investment and financial performance in export-focused companies in China.

Therefore, before the survey was carried out, the benefits of using Web 2.0 technologies for knowledge sharing in Polish manufacturing enterprises were defined by five managers, and the survey items were modified based on their feedback. As a result, the following benefits were identified: increased competitiveness, increased quality of products, increased customer satisfaction, faster responses to customer needs, easier and faster access to information, increased employee motivation, time saving, cost reduction, increased work productivity.

Therefore, this study expects that knowledge sharing in Polish manufacturing companies will positively influence their efficiency which in turn leads to the first hypothesis.

**H1.** Knowledge sharing in Polish manufacturing companies positively influences their efficiency.

Factors of efficiency in the manufacturing companies were based on feedback surveys and their sources are listed here:

- Efficiency: The degree to which a company benefits from the use of Web 2.0 technologies for knowledge sharing in enterprises:
  - Effic-factor1: I know that in my organisation the use of Web 2.0 technologies is not very important for the company's success.
  - Effic-factor2: I know that in my organisation the use of Web 2.0 technologies is quite important for the company's success.
  - Effic-factor3: I know that in my organisation the use of Web 2.0 technologies is very important for the company's success.
- Knowledge sharing in the enterprise: The degree of contact between employees by which one employee can help to transform the knowledge and skills of another [21]:
  - KnowShare1: I share my know-how from work with colleagues in my organisation infrequently.
  - KnowShare2: I share my know-how from work with colleagues in my organisation frequently.
  - KnowShare3: I share my know-how from work with colleagues in my organisation very frequently.

When employees use Web 2.0 technologies for knowledge sharing they feel more motivated to share knowledge. Hence, this leads to hypotheses H2a and H2b.

**H2a:** The sharing of tacit knowledge between employees positively influences the efficiency of a company.

**H2b:** The sharing of explicit knowledge between employees positively influences the efficiency of a company.

The factors of the tacit knowledge of employees in manufacturing companies in terms of the use of Web 2.0 technologies were based on feedback surveys and sources which are listed here:

The tacit knowledge of employees: The degree to which an employee believes that he or she shares his/her knowledge with other company employees:

- EtacitK1: I share my knowledge using Web 2.0 technologies infrequently,
- EtacitK2: I share my knowledge using Web 2.0 technologies frequently,
- EtacitK3: I share my knowledge using Web 2.0 technologies very frequently.

The factors of the explicit knowledge of employees in manufacturing companies in terms of the use of Web 2.0 technologies were based on feedback surveys and sources which are listed here:

The explicit knowledge of employees: The degree to which an employee believes that he or she shares his/her knowledge with other company employees:

- ExplicitK1: I share my work reports and official documents using Web 2.0 technologies infrequently,
- ExplicitK2: I share my work reports and official documents using Web 2.0 technologies frequently,
- ExplicitK3: I share my work reports and official documents using Web 2.0 technologies very frequently.

The aim of this study is to explore the impact of knowledge sharing on the efficiency of Polish manufacturing companies. As presented in Figure 1, the research model posits, from the preceding argument, that both employee-based tacit and explicit knowledge sharing in Polish manufacturing enterprises will have a positive influence upon the defined benefits in these firms.

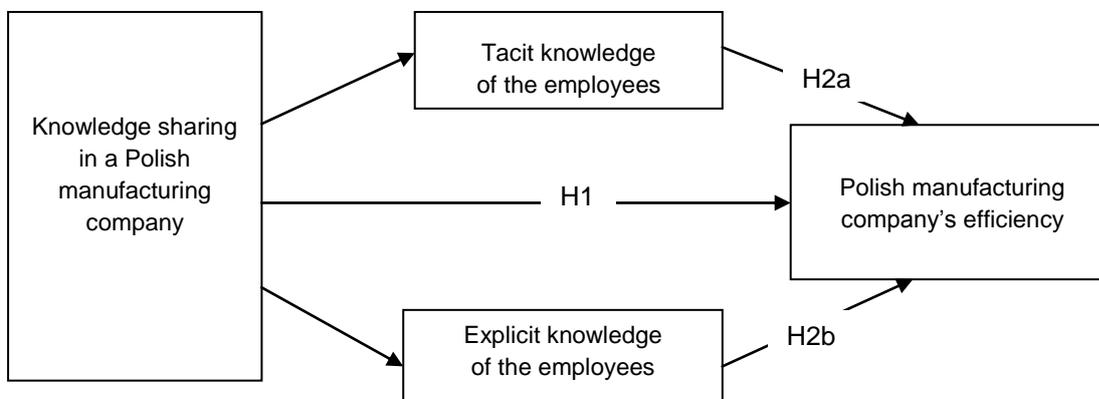


Figure 1. Research model

The following section describes the item measurement and data collection carried out in my research.

### 3 Measures and method

The objective of this study was to investigate on how knowledge sharing using Web 2.0 technologies can increase effectiveness in the Polish manufacturing companies. The survey for testing the research model

was developed by defining scales to fit the knowledge sharing context. A three-point scale was used for all survey items, ranging: 'disagree' (one point), 'agree' (two points), 'strongly agree' (three points). The data for this study were collected from 25 Polish manufacturing companies (see Table 1).

The survey was conducted in April 2013 through the use of direct interviews with respondents.

Table 1: Profile of companies and respondents

	Items	Frequency (N=25)
Industry	Construction	12 (48%)
	Automotive	8 (32%)
	Others	5 (20%)
Department of the company in which the respondent works	Manager	20 (80%)
	Research and Development	2 (8%)
	Marketing and sales	3 (12%)
	Others	0 (0%)

#### 4 Research results and structural model

The research model was analysed using a correlation and further regression approach in order to estimate the effect of knowledge sharing between employees in Polish manufacturing companies. A moderated correlation approach using Statistica ver. 10.0 was used to test the hypotheses. The data were carefully examined with respect to linearity, equality of variance and normality. No significant deviations were detected. Table 2 presents descriptive correlations for the main variables. The study tests the hypotheses using correlation analysis because an interaction effect exists only if the interaction term makes a significant contribution.

Table 2 presents descriptive correlations for the main variables. This includes the results of the correlation analyses which estimate the effect of knowledge sharing in Polish manufacturing companies – both tacit and explicit – as well as their interaction on the efficiency of a company. The primary interaction of knowledge sharing makes a significant contribution to one of the main benefits of the use of Web 2.0 technologies for knowledge sharing in enterprises, namely: saving time (corr = 0.418621). The second interaction of tacit knowledge is also significant and substantially represents the other main benefits from the use of Web 2.0 technologies for knowledge sharing in enterprises: increased competitiveness (corr = -0.449430) and increased quality of products (corr = -0.422687). The third interaction of explicit knowledge sharing makes a significant contribution to one of the main benefits of the use of Web 2.0 technologies for knowledge sharing in enterprises, namely: saving time (corr = 0.447911).

To determine the nature of significant interactions of tacit and explicit knowledge sharing in Polish manu-

facturing enterprises, the study tests the hypotheses using regression analyses which estimate the effect of knowledge sharing on the efficiency of a company. Furthermore, the effect of knowledge sharing on the dependent variable for values of benefits from the use of Web 2.0 technologies is analysed.

Table 2 and Fig. 2 show the results of the first hypothesis which tests the structural relationship between the latent variables. For H1, I examined the effects of knowledge sharing in Polish manufacturing companies on their efficiency, respectively. As Table 2 and Fig. 2 show the effect of using information exchange forums and has the value: 0.418621, by this it is evident that the hypothesis was supported and that there are clear benefits to the use of information sharing among employees using Web 2.0 technologies. To determine the nature of this significant interaction, the study plots the effect (see Fig. 2): *company efficiency: saving time* = 1.1733 + 0.41111 as a result of using information exchange forums. The *company efficiency: saving time* clearly increases with knowledge sharing in Polish manufacturing companies, when facing high values for using information exchange forums. However, when given low values for using the information exchange forums, a decrease in company efficiency is evident. This finding offers support for hypothesis H1.

Contrary to hypothesis H2a, tacit knowledge sharing has an effect on company efficiency, but is not positively correlated. As Table 2 and Figs. 3 and 4 show, the effect of using an expert catalogue on the benefits of the use of Web 2.0 technologies for knowledge sharing in enterprises, such as increased competitiveness, has the value 0.449430 and increased quality of products, has the value -0.422687. Therefore, this hypothesis was not supported.

Table 2. Correlations analysis

Construct	Item/Factor	Correlation	r2	t	p
Information Exchange Forums Increased competitiveness	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.013700	0.000188	-0.06571	0.948178
Information Exchange Forums Increased quality of products	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	0.119334	0.014241	0.57642	0.569928
Information Exchange Forums Increased Customer Satisfaction	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	0.046225	0.002137	0.22192	0.826331
Information Exchange Forums Faster response to customer needs	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.131306	0.017241	-0.63522	0.531552
Information Exchange Forums Easier and faster access to the information	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	0.150329	0.022599	0.72924	0.473216
Information Exchange Forums Increased Employee motivation	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.251976	0.063492	-1.24873	0.224326
Information Exchange Forums Saving time	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	<b>0.418621</b>	<b>0.175243</b>	<b>2.21066</b>	<b>0.037279</b>
Information Exchange Forums Cost reduction	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	0.012155	0.000148	0.05830	0.954014
Information Exchange Forums Increased work productivity	KnowShare1/KnowShare2/ KnowShare3 Effic-factor1/Effic-factor2/ Effic-factor3	0.182717	0.033385	0.89128	0.382006
Expert catalogue Increased competitiveness	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	<b>-0.449430</b>	<b>0.201987</b>	<b>-2.41280</b>	<b>0.024203</b>
Expert catalogue Increased quality of products	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	<b>-0.422687</b>	<b>0.178665</b>	<b>-2.23678</b>	<b>0.035287</b>
Expert catalogue Increased customer Satisfaction	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.261305	0.068280	-1.29828	0.207059
Expert catalogue Faster response to customer needs	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.292037	0.085286	-1.46440	0.156621
Expert catalogue Easier and faster access to the information	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.025540	0.000652	-0.12253	0.903546
Expert catalogue Increased employee motivation	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	0.046701	0.002181	0.22422	0.824568
Expert catalogue Saving time	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	0.008388	0.000070	0.04023	0.968259
Expert catalogue Cost reduction	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.322164	0.103789	-1.63206	0.116285
Expert catalogue Increased work productivity	EtacitK1/EtacitK2/EtacitK3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.091012	0.008283	-0.43830	0.665260
Instant messaging; dedicated information system Increased competitiveness	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.102537	0.010514	-0.49435	0.625745
Instant messaging; dedicated information system Increased quality of products	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	0.214147	0.045859	1.05140	0.303996
Instant messaging; dedicated information system Increased customer Satisfaction	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	0.186641	0.034835	0.91111	0.371688
Instant messaging; dedicated information system Faster response to customer needs	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	0.137931	0.019025	0.66788	0.510859
Instant messaging; dedicated information system Easier and faster access to the information	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	0.224533	0.050415	1.10504	0.280569
Instant messaging. dedicated information system Increased employee motivation	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	-0.111666	0.012469	-0.53890	0.595134
Instant messaging; dedicated information system Saving time	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	<b>0.447911</b>	<b>0.200625</b>	<b>2.40260</b>	<b>0.024745</b>
Instant messaging; dedicated information system Cost reduction	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	0.258566	0.066856	1.28369	0.212033
Instant messaging; dedicated information system Increased work productivity	ExplicitK1/ExplicitK2/ExplicitK3 Effic-factor1/Effic-factor2/ Effic-factor3	0.242918	0.059009	1.20097	0.241986

To determine the nature of this significant interaction, the study plots the effect (see Fig. 3 and Fig. 4): *company efficiency: increased competitiveness* =  $2.5821 - 0.3378$  using the expert catalogue and *company efficiency: increased quality of products* =  $2.7634 - 0.3282$  using the expert catalogue. So, according to these results, company efficiency clearly decreases with tacit knowledge sharing in Polish manufacturing companies. This finding offers no support for hypothesis H2a.

For H2b, I examined the effects of explicit knowledge sharing on company efficiency respectively. As Table 2 and Fig. 5 show, the effect of explicit knowledge shar-

ing on *company efficiency: saving time*, has a value of 0.447911 and is statistically significant, providing support for H2b. To determine the nature of this significant interaction, the study plots the effect (see Fig. 5): *company efficiency: saving time* =  $1.1893 + 0.43319$  using an instant messaging dedicated information system. The *company efficiency: saving time* clearly increases with explicit knowledge sharing in Polish manufacturing companies, when facing high values for using an instant messaging dedicated information system.

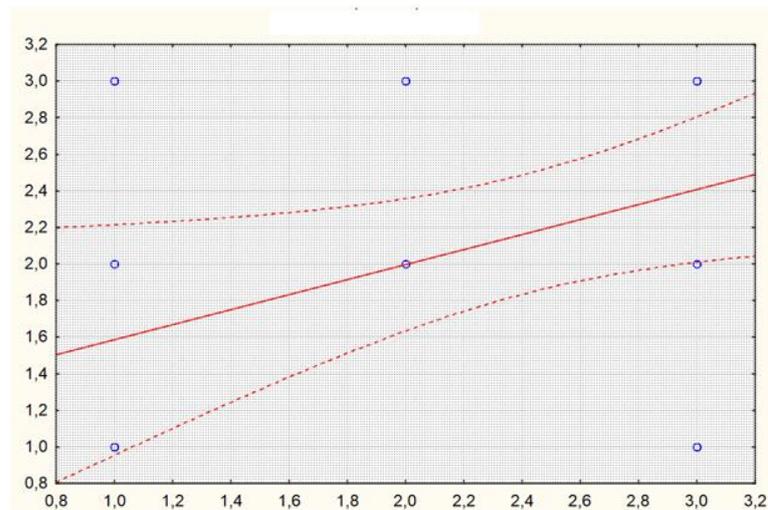


Figure 2. Interactions involving knowledge sharing and company efficiency

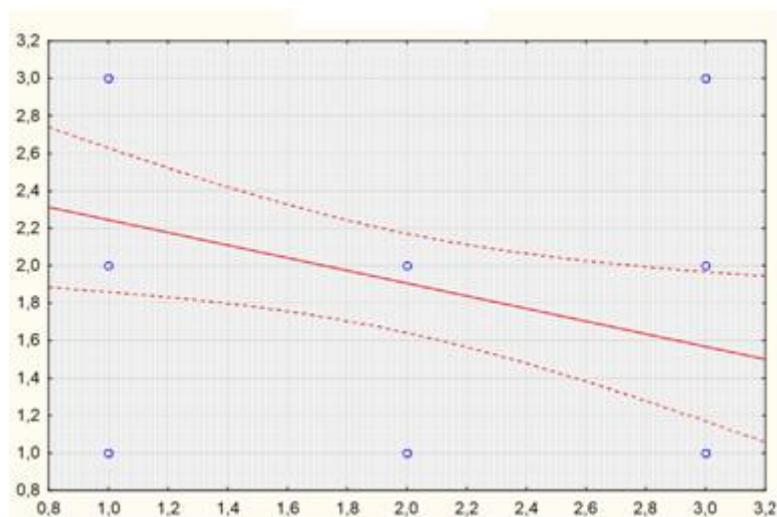


Figure 3. Interactions involving tacit knowledge sharing and company efficiency (increased competitiveness)

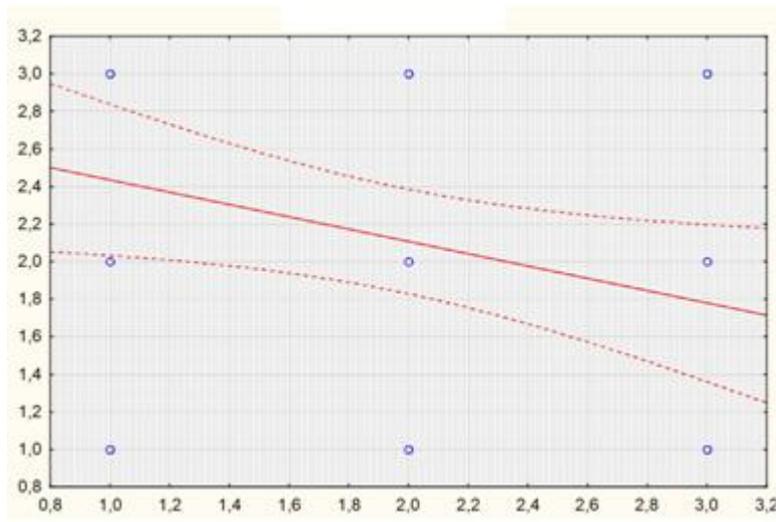


Figure 4. Interactions involving tacit knowledge sharing and company efficiency (increased quality of products)

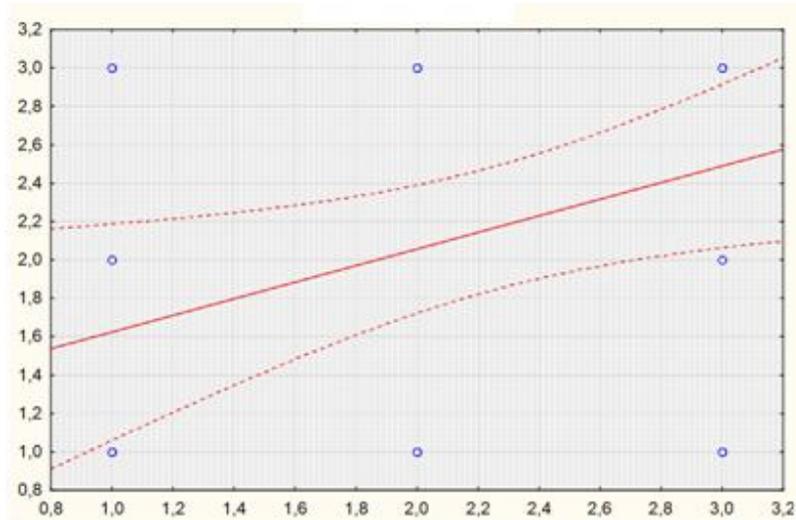


Figure 5. Interactions involving explicit knowledge sharing and company efficiency

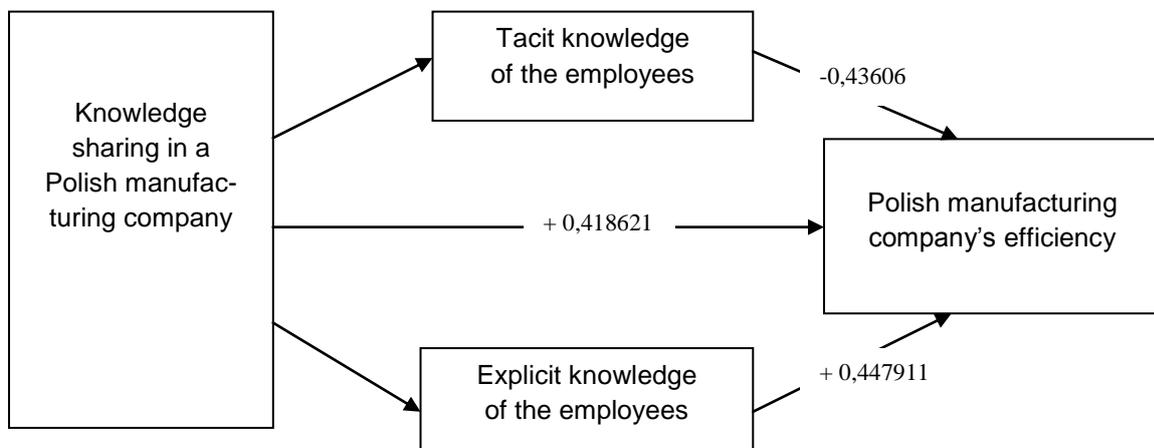


Figure 6. Analysis of the results

This study does not just testify to the influence of knowledge sharing on company efficiency, but also explores how this mechanism works through the use of Web 2.0 technologies for knowledge sharing in enterprises. The structural model results are shown in Fig. 6.

## 5 Conclusions and recommendations

This section of the paper summarises the new findings of this study and discusses the implications.

This research analyses the effects of knowledge sharing in Polish manufacturing companies. It is based on using a comprehensive framework that integrates three research streams: tacit and explicit knowledge and company efficiency.

Some studies empirically discussed the effects of knowledge sharing on various aspects. By proposing a model which addresses the influence of explicit and tacit knowledge sharing on the benefits of the use of Web 2.0 technologies for knowledge sharing in enterprises, this study contributes to filling the gap which exists in the literature.

The empirical findings of this study confirm the general hypothesis, except the second part as it was found that tacit knowledge sharing decreases company efficiency. It is therefore clear that discerning the type of knowledge sharing involved can significantly deepen our understanding of the contingent effect that such sharing has on company efficiency. Moreover, this study suggests that it may not be the best idea to implement Web 2.0 technologies that facilitate the sharing of tacit knowledge, because they could decrease company efficiency.

Like all studies, this one has certain limitations that further research should aim to overcome. Firstly, because the intention is to analyse knowledge sharing, this study focuses on Polish manufacturing industries which traditionally use some form of Web 2.0 technology. It would be unwise to generalise the findings too broadly to other enterprises.

Furthermore, all the variables are measured at the same moment in time. So, it would be useful to provide such research over a longer time period and at different stages. These conclusions and limitations suggest proposals for future research direction, such as exploring additional factors that could improve the effect of knowledge sharing on company efficiency.

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## PROJECT PARAMETER ESTIMATION ON THE BASIS OF AN ERP DATABASE

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**Abstract:** Nowadays, more and more enterprises are using Enterprise Resource Planning (ERP) systems that can also be used to plan and control the development of new products. In order to obtain a project schedule, certain parameters (e.g. duration) have to be specified in an ERP system. These parameters can be defined by the employees according to their knowledge, or can be estimated on the basis of data from previously completed projects. This paper investigates using an ERP database to identify those variables that have a significant influence on the duration of a project phase. In the paper, a model of knowledge discovery from an ERP database is proposed. The presented method contains four stages of the knowledge discovery process such as data selection, data transformation, data mining and interpretation of patterns in the context of new product development. Among data mining techniques, a fuzzy neural system is chosen to seek relationships on the basis of data from completed projects stored in an ERP system.

**Key words:** knowledge management, new product development, knowledge discovery in databases, data mining, ERP system.

### 1 Introduction

In recent years, the advancement of information technology in business management processes has placed Enterprise Resource Planning (ERP) system as one of the most widely implemented business software in various enterprises. The use of an ERP system is especially significant in the production enterprises, in which a number of operational processes is enormous. ERP is a system for the seamless integration of all the information flowing through the company such as finances, accounting, human resources, supply chain and customer information [8]. The primary task of an integrated system is to maintain the data flow of an organisation and to reduce the redundancy [12, 16].

The present information and communication technologies have become one of the most important factors, conditions and chances of the company development. These technologies enable the collection, presentation, transfer, access and using of enormous amount of data. The data are a potential source of information that in connection with manager skills and experience may influence on the choice of the correct decision. ERP systems help to collect, operate and store data concerning daily activities of an enterprise (e.g. client orders), as well as the results of previous projects (development of products) [14, 24].

One of the functionalities of an ERP system concerns project management that a company can use to develop

new products. Project management can be supported by knowledge management [9], for instance in the context of information acquisition for project financing [13]. To obtain a project schedule, there is required data specification concerning resources and activities, including their sequence and duration. Project parameters can be specified by the experts or estimated with the use of an ERP database. First approach is suitable for the projects that have very unique form, e.g. for the construction projects. In turn, if an enterprise develops new products and a new version of product is connected with the superficial modification of a product specification, then it is possible to acquire the knowledge from the ERP database and to use it for the improvement of estimation quality of project parameters.

The goal of this paper is to present the possibility of the use of the ERP database for seeking the relationships between the ERP attributes (e.g. delay of material delivery by suppliers, number of subcontractors, team members) and the project parameters (e.g. project duration).

The sought relationships can support the user in the assessment of project parameters, and as a consequence to obtain the more relevant estimates. It is unrealistic to expect very accurate estimates of project effort because of the inherent uncertainty in development projects, and the complex and dynamic interaction of factors that influence on its development.

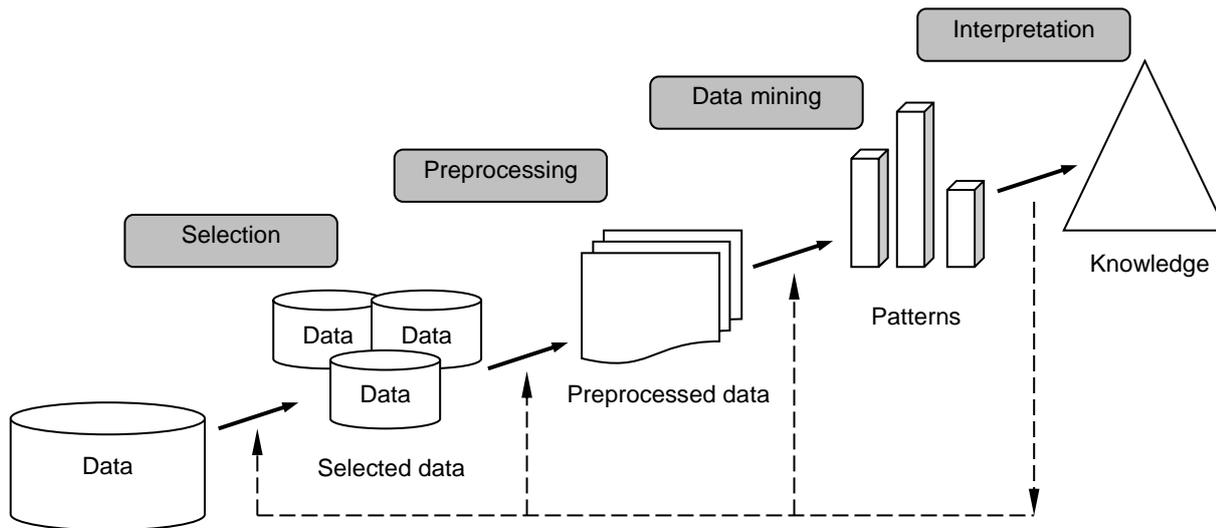


Figure 1. Model of knowledge discovery  
(source: self study base on [10])

However, even a small improvement in the estimation quality can influence positively on planning and monitoring the project, for instance, in project cost, resource allocation and schedule arrangement. This is the motivation to try to use the ERP database in order to discover the useful patterns.

## 2 Model of a knowledge discovery in databases

The knowledge discovery in databases (KDD) is concerned with the development of methods and techniques for making sense of data. KDD is the nontrivial process of identifying valid, novel, potentially useful and ultimately understandable patterns in data. The basic problem addressed by the KDD process is one of mapping low-level data (which are typically too voluminous to understand and digest easily) into other forms that might be more compact (e.g. a short report), more abstract (e.g. a descriptive approximation or model of the process that generated the data), or more useful (e.g. a predictive model for estimating the value of future cases). At the core of the process is the application of specific data-mining methods for pattern discovery and extraction [10].

One of the most used methodologies for developing data mining and knowledge discovery projects is CRoss-Industry Standard Process for Data Mining (CRISP-DM) and KDD process proposed by Fayyad

et al. CRISP-DM states which tasks have to be carried out to complete a data mining project.

This methodology consists of the following stages: business understanding, data understanding, data preparation, modelling, evaluation and deployment [15]. In turn, KDD process includes nine steps: developing and understanding of the application domain, creating a target data set, data cleaning and preprocessing, data reduction and projection, choosing the DM task, choosing the DM algorithm, DM, interpreting mined patterns and consolidating discovered knowledge [10].

The steps of the KDD process in the above-presented models can generally be grouped into four main tasks:

- data selection,
- data preprocessing,
- data mining,
- interpretation of patterns.

Figure 1 presents the model of KDD process that is further considered in the context of knowledge acquisition from an ERP database.

The data selection step is connected with an understanding of the application domain and the relevant prior knowledge and identification of the goal of the KDD process from the customer's viewpoint. This step also concerns creating a target data set: selecting a data set, or focusing on a subset of variables or data samples for the knowledge discovery.

Second step – data preprocessing consists of data cleaning, preprocessing and reduction. Basic operations include removing noise if appropriate, collecting the necessary information to model or account for noise, deciding on strategies for handling missing data fields, accounting for time-sequence information and known changes, finding useful features to represent the data depending on the goal of the task.

With dimensionality reduction or transformation methods, the effective number of variables under consideration can be reduced, or invariant representations for the data can be found [10].

Data mining step includes choosing the data mining algorithm(s), selecting method(s) to be used for searching for data patterns, and searching for patterns of interest in a particular representational form or a set of such representations, including classification rules or trees, regression and clustering. The user can significantly aid the data mining method by correctly performing the preceding steps.

Fourth step consists of interpreting mined patterns and sometimes the visualisation of the extracted patterns and models or visualisation of the data given the extracted models. The discovered knowledge can be used directly, incorporating the knowledge into another system for further action, or simply documenting it and reporting it to interested parties. This step also includes checking for and resolving potential conflicts with previously believed (or extracted) knowledge. It is noteworthy that the KDD process can involve iterations and can contain loops between any two steps [10].

The knowledge acquisition from an ERP system requires using the KDD methods that are suitable for the characteristics of an ERP database. The proposed method for seeking relationships in the order of project parameter estimation is presented in the next section.

### 3 Method for project parameter estimation in the context of ERP systems

The presented method is dedicated for the production enterprises that use an ERP system also to develop the new products. The phases of product development depend on the characteristics of product and company, in which it is designed. However, some common phases can be distinguished, for example [1]:

- plan and define programme,

- product design and development verification,
- process design and development verification,
- product and process validation,
- production.

These phases can also be considered in the context of concept initiation, programme approval, prototype, pilot and launch. Each phase requires the specification of duration and cost. In each of these phases, the critical factors (parameters of an ERP database) that significantly influence on new product development are sought. The estimation of these parameters is especially desired in the medium and large enterprises that develop a few new products simultaneously. In the case of significant variance of a project parameter, the use of the average or time series models can result in the inaccurate estimates. Thus, the search of conditional rules using an ERP database is proposed. The sought relationships can improve the quality of estimates that are input into an ERP system, in a project management module.

Among the KDD steps, two steps seem to be especially important in the context of knowledge acquisition from an ERP database, i.e. data selection and data mining. An ERP database contains dozens of attributes that can be irrelevant to the mining task or redundant. To reduce the data set size, attribute (feature) subset selection can be used that removes irrelevant or redundant attributes (or dimensions). The goal of attribute subset selection is to find a minimum set of attributes such that the resulting probability distribution of the data classes is as close as possible to the original distribution obtained using all attributes. Mining on a reduced set of attributes has an additional benefit. It reduces the number of attributes appearing in the discovered patterns, helping to make the patterns easier to understand [11]. One of the variable reduction methods is principal component analysis that reduces the dimension for linearly mapping high dimensional data onto a lower dimension with minimal loss of information.

Knowledge acquisition requires some data mining techniques that cope with the description of relationships among data and that solve the problems connected with e.g. classification, regression and clustering. These techniques include neural networks, fuzzy sets, rough sets, time series analysis, Bayesian networks, decision trees, evolutionary programming and genetic algorithms, Markov modelling, etc. Data mining should be connected with matching the goals of the KDD process from the user's viewpoint to a particular methods,

Table 1. Input variables for product prototype phase  
(source: *self study*)

Suppliers	Materials Management	Production	Project Management
Value of material purchase	Number of materials in warehouses	Productive capacity (actual/maximal)	Number of standard tasks in the project phase
Number of suppliers selling required materials	Number of warehouse transfers	Number of resource overloads	Number of unique tasks in the project phase
Number of delivery reminder documents		Time of machine inspection	Number of changes in the project phase specification
Delivery duration		Number of machines	Number of subcontractors
Delay of delivery		Number of work orders	Number of team members
			Number of materials needed in the project phase

for example, summarisation, classification, regression, clustering. Blind application of data mining methods can lead to the discovery of meaningless and invalid patterns [10].

Database of an ERP system comprises an enormous number of parameters that can be considered as potential variables to identify the project parameters. One of the data mining techniques is fuzzy neural system that can take into account the imprecise character of data, cope with enormous amount of data, and identify the relationships among data.

Fuzzy logic and artificial neural networks are complementary technologies and powerful design techniques that can be used in the identification of patterns from among a large database and noisy data.

The fuzzy neural system has the advantages of both neural networks (e.g. learning abilities, optimisation abilities and connectionist structures) and fuzzy systems (simplicity of incorporating expert knowledge). As a result, it is possible to bring the low-level learning and computational power of neural networks into fuzzy systems and also high-level human like IF-THEN thinking and reasoning of fuzzy systems into neural networks.

The fuzzy neural method is rather a way to create a fuzzy model from data by some kind of learning method that is motivated by learning procedures used in neural networks. This substantially reduces development time and cost while improving the accuracy of the resulting fuzzy model. Being able to utilise a neural learning algorithm implies that a fuzzy system

with linguistic information in its rule base can be updated or adapted using numerical information to gain an even greater advantage over a neural network that cannot make use of linguistic information and behaves as a black box [2].

The behaviour of a fuzzy neural system can be represented by a set of humanly understandable rules or by a combination of localised basis functions associated with local models, making them an ideal framework to perform nonlinear predictive modelling. Nevertheless, one important consequence of this hybridisation between the representational aspect of fuzzy models and the learning mechanism of neural networks is the contrast between readability and performance of the resulting model [2].

The combination of fuzzy systems and neural networks has recently become a popular approach in engineering fields for solving problems in control, identification, prediction, pattern recognition, etc. [6–7, 26]. One well-known structure is the adaptive neuro-fuzzy inference system (ANFIS) that is a universal approximator and enables the non-linear modelling and forecasting [17].

#### 4 Illustrative example

The following example refers to four steps of knowledge discovery from an ERP database in the context of new product development. The output variable is the duration (in days) of the  $j$ -th phase in project  $i$ . In turn, the input variables of the  $j$ -th phase in project  $i$  are presented in Table 1.

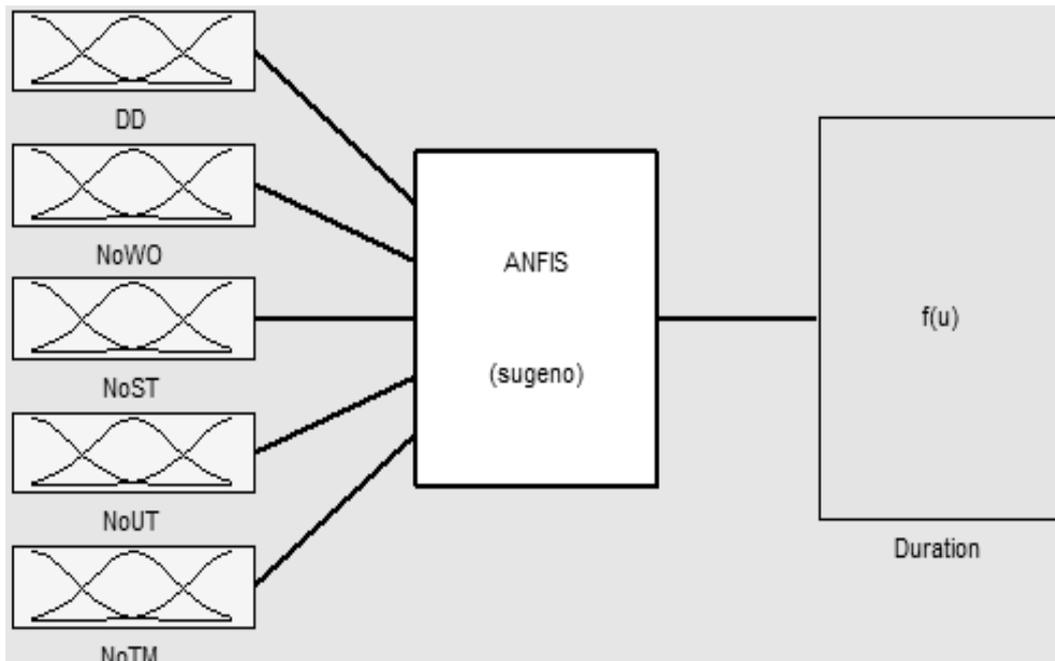


Figure 2. Structure of adaptive neuro-fuzzy inference system  
(source: self study)

These variables are derived from the ERP system modules that are connected with new product development (project management). The development of a product prototype requires the purchase of materials from the suppliers, storage of materials and usage of materials in production. The first step of the knowledge discovery process concerns data selection and it can be divided into two approaches: the expert chooses the data according to his/her experience and the use of one of the variable reduction methods. The input variables presented in Table 1 have been chosen according to the expert approach. All these variables have the numerical format, but different units, for example, purchasing is in monetary unit, delivery duration in days and productive capacity in percent.

Therefore, the data requires transformation before one of the variable reduction methods is used. The principal component analysis has been chosen as the variable reduction method. This analysis transforms the input data so that the elements of the input vectors will be uncorrelated. In addition, the size of the input vectors may be reduced by retaining only those components that contribute more than a specified fraction of the total variation in the data set. After the use of principal component analysis, the data set has been reduced from 18 input variables to 5 (Delivery duration – DD, Number of work orders – NoWO, Number of standard tasks in the project phase – NoST, Number of unique tasks

in the project phase – NoUT, Number of team members – NoTM). Moreover, the data set has been normalised so that it has a zero mean. Data preprocessing (transformation) is the second step of the knowledge discovery process and helps a fuzzy neural system obtain more accurate results.

The third step of the knowledge discovery process regards to the use of data mining techniques/tools. In the order to seek relationships, the adaptive neuro-fuzzy inference system (ANFIS), which is the tool of Matlab<sup>®</sup> software, has been applied. Figure 2 presents the structure of ANFIS for the duration of project prototype phase.

In order to eliminate the overtraining of ANFIS (too strictly function adjustment to data) and to increase the estimation quality, the data set is divided into learning (P1-P12) and testing set (P13-P15). The learning phase requires the declaration of a membership function type of fuzzy sets (e.g. triangular, Gaussian function), defuzzification method, method of weights optimisation and stop criterion (e.g. error value or the number of iteration). ANFIS tool proposes two methods concerning the identification of the shape of membership functions: grid partition and subtractive clustering method. The shape of membership functions for input variables is presented in Fig. 3.

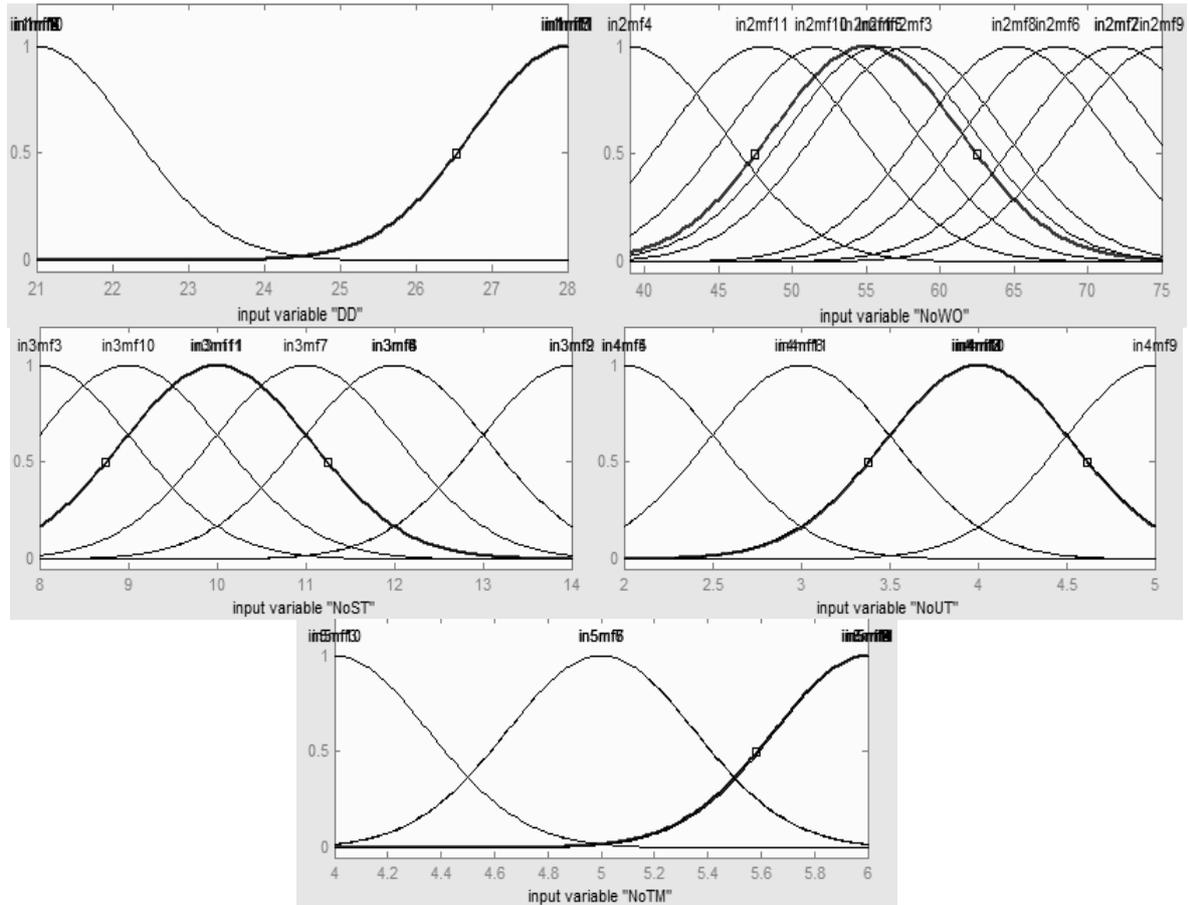


Figure 3. Membership function for input variables  
(source: self study)

1. If (DD is in1mf1) and (NoWO is in2mf1) and (NoST is in3mf1) and (NoUT is in4mf1) and (NoTM is in5mf1) then (Duration is out1mf1) (1)
2. If (DD is in1mf2) and (NoWO is in2mf2) and (NoST is in3mf2) and (NoUT is in4mf2) and (NoTM is in5mf2) then (Duration is out1mf2) (1)
3. If (DD is in1mf3) and (NoWO is in2mf3) and (NoST is in3mf3) and (NoUT is in4mf3) and (NoTM is in5mf3) then (Duration is out1mf3) (1)
4. If (DD is in1mf4) and (NoWO is in2mf4) and (NoST is in3mf4) and (NoUT is in4mf4) and (NoTM is in5mf4) then (Duration is out1mf4) (1)
5. If (DD is in1mf5) and (NoWO is in2mf5) and (NoST is in3mf5) and (NoUT is in4mf5) and (NoTM is in5mf5) then (Duration is out1mf5) (1)
6. If (DD is in1mf6) and (NoWO is in2mf6) and (NoST is in3mf6) and (NoUT is in4mf6) and (NoTM is in5mf6) then (Duration is out1mf6) (1)
7. If (DD is in1mf7) and (NoWO is in2mf7) and (NoST is in3mf7) and (NoUT is in4mf7) and (NoTM is in5mf7) then (Duration is out1mf7) (1)
8. If (DD is in1mf8) and (NoWO is in2mf8) and (NoST is in3mf8) and (NoUT is in4mf8) and (NoTM is in5mf8) then (Duration is out1mf8) (1)
9. If (DD is in1mf9) and (NoWO is in2mf9) and (NoST is in3mf9) and (NoUT is in4mf9) and (NoTM is in5mf9) then (Duration is out1mf9) (1)
10. If (DD is in1mf10) and (NoWO is in2mf10) and (NoST is in3mf10) and (NoUT is in4mf10) and (NoTM is in5mf10) then (Duration is out1mf10) (1)
11. If (DD is in1mf11) and (NoWO is in2mf11) and (NoST is in3mf11) and (NoUT is in4mf11) and (NoTM is in5mf11) then (Duration is out1mf11) (1)

Figure 4. Fuzzy rules for duration assessment  
(source: self study)

According to the shape of membership functions, the rules are built. The example of fuzzy rules for the duration is presented in Fig. 4.

After learning phase, the testing data are led to input of system to compare the error between different models. Root mean square errors (RMSE) for various models are presented in Table 2.

Table 2. Comparison of RMSE for different models  
(source: self study)

Model	RMSE
Average	13.06
Linear model	12.65
ANFIS – grid partition	5.88
ANFIS – subtractive clustering	3.74

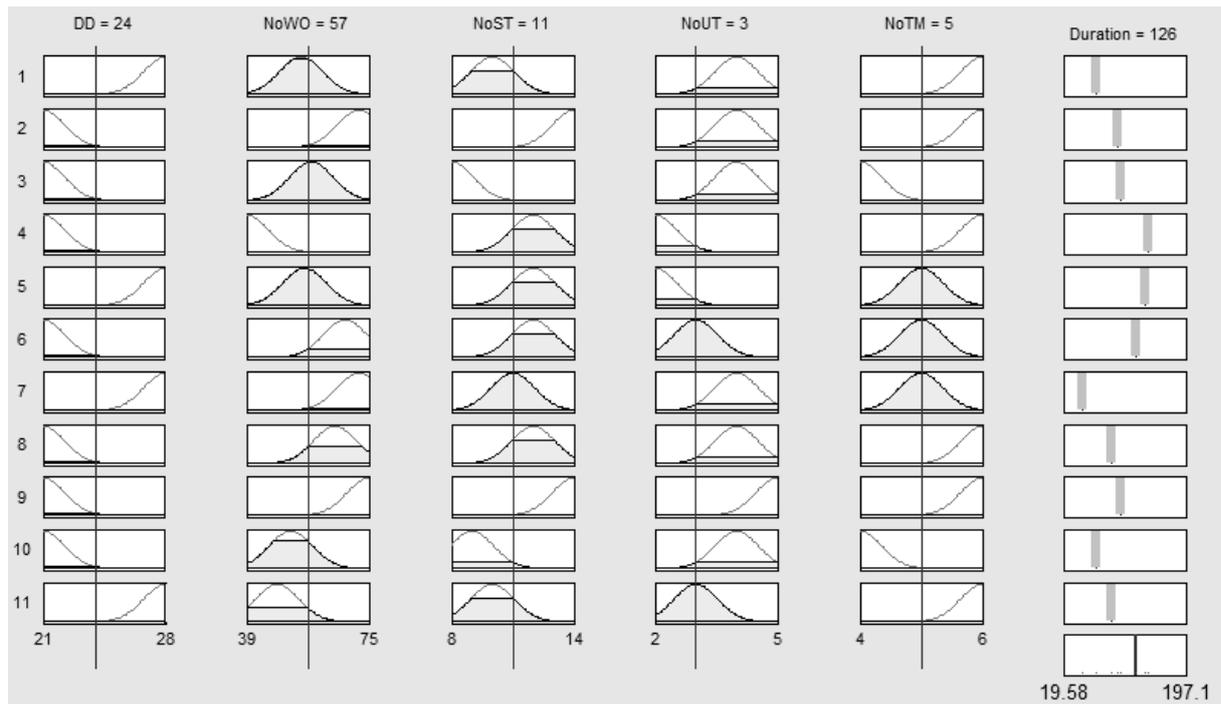


Figure 5. Estimation of project duration  
(source: self study)

The least error in testing set for the duration of project prototype phase has been generated with the use of ANFIS with subtractive clustering method. The comparison of different models is especially recommended in the case of low level of variance for a dependant variable (in the considered case for the duration of a project phase). The membership functions and rules are a basis to evaluate the duration of an actual project. Let us assume that for the actual project are considered the following values: delivery duration – 24 days, number of work orders – 57, number of standard tasks in the project phase – 11, number of unique tasks in the project phase – 3, and number of team members – 5.

Figure 5 presents the memberships functions for 8 rules that determine the planned duration of project phase at 126 days.

The presented analysis can be broadened into multidimensional analysis to support the decision-maker in determining optimal values of some parameters. For instance, the decision-maker would like to know the number of team members (from 5 to 6) and the number of work orders (from 55 to 65), for which the planned duration of project phase is the least. Table 3 presents the results for the above-mentioned constraints. The results indicate that the minimal duration is for 6 members of project team and 55 number of work orders. Moreover, the increase of project duration at 5 team members is proportionally larger than at 6 members

Table 3. Example of what-if analysis for project duration  
(source: self study)

Number of work orders	Number of team members	
	5	6
55	122	88.0
56	124	88.5
57	126	89.4
58	127	90.4
59	129	92.2
60	131	93.8
61	133	95.6
62	134	97.4
63	136	99.2
64	138	101.0
65	139	103.0

For instance, the reduction of work orders from 60 to 55 for 5 team members decreases project duration by 9 days (131 days – 122 days), whereas for 6 team members, the decline equals about 6 days (93.8 days – 88 days). In the case of extensive search space, the time of obtained solution can be significantly reduced, e.g. using constraints programming languages [4–5, 18–21, 25]. The above-presented analysis is conducted for each phase of project and the obtained estimates can be used for further evaluation, e.g. in the planning of cash flow, working capital and financial reserves.

## 5 Closing remarks

The knowledge discovery process in the context of an ERP database can be considered as four steps: data selection, data transformation, data mining and pattern interpretation. An enormous number of data and attributes in an ERP database require paying attention to the proper choice of variable reduction and data mining methods. In the paper, the principal component analysis has been chosen as the variable reduction method and the fuzzy neural system as data mining technique.

The fuzzy neural system has the advantages of both neural networks (e.g. learning abilities, optimisation abilities and connectionist structures) and fuzzy systems (simplicity of incorporating expert knowledge). As a result, it is possible to bring the learning and computational power of neural networks into fuzzy systems and also human like if-then thinking and reasoning of fuzzy systems into neural networks.

The advantages of proposed approach include the search of conditional rules into an ERP database and using them for the project parameter estimation. This is especially important in the case of significant variance of a project parameter, for which the average and time series models result in the inaccurate estimates. More exact identification of project duration and cost enables more precision of project planning and control, as well as the improvement of cash flow planning. The proper choice of a set of new products can lead to increasing the market share, profitability and liquidity of an enterprise. The proposed approach is especially valuable for an enterprise that has a database of past projects, because there is the possibility to gather additional information in the form of conditional rules. The application of the proposed approach encounters some difficulties, among other things, by the collecting enough amounts of data of the past similar projects. Moreover, the lack of uniform rules that concern the development of fuzzy neural systems may cause an acceptance problem for the decision-makers. However, the presented approach seems to have the promising properties for acquiring information from an ERP system.

Further research focuses on the development of the proposed method for project parameter estimation in the context of ERP systems, for instance, towards the choice of an optimal set of new products with the use of constraint programming techniques. The value of discovered patterns obviously depends on the quality of database of an ERP system.

The data quality can be improved through using standards or methodology (according to the certification process) for managing of the project [22], proper project communication [23] and the education approach in an organisation [3]. Hence, future research can be aimed at adjusting the proposed approach in the aspect of other project factors, including the improvement of training system in the company and communication in the project team.

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## DEVELOPING A NEW PROJECT EVALUATION SYSTEMS BASED ON KNOWLEDGE

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**Abstract:** The article is dedicated to the modelling of a new project evaluation systems based on knowledge. Author suggests possible direction of project evaluation systems development. This enabled the application of data mining algorithms for discovering patterns in data sets. The concept of a new evaluation system based on knowledge is synthetically discussed. The example of using association rule base for analysis of project stakeholders surveys is also presented.

**Keywords:** project evaluation systems, systems based on knowledge, modelling of a new project evaluation systems, stakeholders analysis, association rules.

### 1 Introduction

The ability of creating new knowledge and using it in the process of projects realisation plays an important role in the process of solving multifaceted problems in global and turbulent contextual environment of organisations. In modern enterprises projects mostly decide based on obtained results. Not only they support a continuous improvement of core processes but also contribute to making a transformational change on a strategic level<sup>1</sup>.

Multidimensional and comprehensive project evaluation is increasingly important nowadays<sup>2</sup>. Depending on the type of evaluation, it can be used to make different decisions. They may concern, e.g. selection of projects for implementation, continuation of its realisation or summary of the results achieved at the end of the project. The evaluation process is characterised by an interdisciplinary nature. This process requires conducting structuring evaluation approaches for collecting data, information and knowledge, which then must be analysed using interdisciplinary methods and systems<sup>3</sup>.

Systems based on knowledge should play an important part among interdisciplinary evaluation approaches. The process of project evaluation requires knowledge management. Knowledge is fundamental in the process of project management and evaluation. Proper management of knowledge about evaluation is intended to

increase knowledge about the evaluated current project, which can also be used in the implementation of other planned projects.

Appropriate project management knowledge and ability of improving that knowledge play key roles in achieving organisation's success<sup>4</sup>. Project management can be defined as a field that uses the available and specific knowledge and skills, methods and tools to harmonise the interaction of the project's participants in the process of project implementation, reaching its objectives in the assumed time, using available resources<sup>5</sup>.

Application of new knowledge-based technology in this field allows the implementation of computational systems for the analysis of complex, multi-faceted and multi-disciplinary, socio-economic evaluation of uncertainty problems. Research on knowledge-based methods make possible practical solutions in evaluation and require continuation in the context of the necessity of implementation of basic rules of knowledge management and knowledge-based economy. These researches should be carried out on micro- and macroeconomic levels. AI (Artificial Intelligence) approaches are modern implementation methods useful in a knowledge-based company, well functioning, in the information/knowledge age, an information society and digital economy.

<sup>1</sup> Barrows E., Neely A. - *Managing Performance in Turbulent Times: Analytics and Insight*, John Wiley & Sons, Hoboken, New Jersey 2012, p. 67.

<sup>2</sup> Grzeszczyk T.A. - *Towards the Model of Comprehensive Project Evaluation System*, Monographic Series of Faculty of Management, ed. T. Krupa, Warsaw University of Technology, Warsaw 2013.

<sup>3</sup> Grzeszczyk T.A. - *Evaluation of European Projects 2007-2013*, Placet, Warszawa 2009 (in polish).

<sup>4</sup> Love P., Fong P., Irani Z. (eds.) - *Management of Knowledge in Project Environments*, Routledge, 2005, pp. IX-X.

<sup>5</sup> Trocki M., Bukłaha E., Gruzca B. - *Projects and Project Management* [in] Knowledge Management in Projects. Methodologies, Models of Competence and Maturity Models, M. Trocki (ed.), Publishing House Warsaw School of Economics, Warsaw 2011 (in polish), pp. 53-54.

Realisation of research on knowledge-based systems leads to the development of management sciences. Knowledge technologies can be used, e.g. in a multi-criteria process of decision making relating to comprehensive project evaluation. A number of socio-economic data of information and knowledge resulting from them is still increasing. It is not possible to realise a comprehensive evaluation process without the use of knowledge technologies and computer systems connected with them. Classical data processing applications are not useful in the case of large, complex, empirical and uncertain data sets.

An evident research gap can be noticed in project evaluation systems. Most evaluation systems which have been known until now concern one-aspect, quantitative and short-term evaluation of project operations. Most of systems adapted to a qualitative analysis of empirical data which come from people (e.g. project stakeholders) is insufficient.

The evaluation system should function in a multi-aspect way. Pursuing to multi-aspectness is equivalent to noticing the need and possibility of building the model of a comprehensive evaluation system<sup>6</sup>. Such a system should take qualitative and quantitative conditions into account. For example, social, economical, environmental, technical, organisational, legal, ecological, cultural and political aspects can be itemised among qualitative aspects. It is important to consider factors such as difficult to measure, permanent and sustainable socio-economic development of regions and other in the process of evaluation of projects realisation in a turbulent environment.

One of the possible concepts of development of project evaluation systems toward complex solutions is integration of various evaluation methods. The author carry out research on possibilities and the need of integration of classical evaluation methods with methods which allow to discover and manage knowledge. Classical evaluation methods are better studied. Thus, there is a need to carry out research on new project evaluation methods and systems based on knowledge.

There is a research assumption that using modern concepts and methods which allow a knowledge discovery and management is an essential condition of correct functioning of the comprehensive evaluation system.

<sup>6</sup> Grzeszczyk T.A. - *Towards the Model of Comprehensive Project Evaluation System* [in] Monographic Series of Faculty of Management, ed. T. Krupa, Warsaw University of Technology, Warsaw 2013.

They can pose an essential complement for classical evaluation methods. In this paper the concept and example of a new evaluation knowledge-based system using selected data mining algorithms has been presented. The implementation of these systems enables well-informed and multiple-aspect decision-making, even in case of comprehensive and multifaceted projects in the global and turbulent environment.

## 2 The essence of an evaluation process

Evaluation plays bigger and bigger role in management sciences. In recent years, theoretical and practical scientific achievements concerning, i.e. improving organisation, management and evaluation of process quality has increased significantly. Many are subject to evaluation process. They are, e.g. project, programme, policy, strategy, process, system, initiative, action, product etc. In this study considerations concern the evaluation of a project or programme.

A project is a system of activities characterised by its parameters: scope, necessary resources (human, knowledge, capital, material, technological) and deadlines<sup>7</sup>. Projects can be assigned to specific programme or occur separately. A programme is a collection (set) of multiple interrelated projects carried out for the implementation of mutually reinforcing policy strategic objectives<sup>8</sup>.

A worldwide respected association, the PMI (Project Management Institute) defines the programme as a 'set (group) of projects which are managed in an integrated and coordinated way'. Individual projects included in the programme are usually combined and relations between them can be identified<sup>9</sup>. Evaluations of policies, programs or projects are the judgement of their value, taking into account the earlier assumptions and criteria on the basis of collected information analysed for this purpose<sup>10</sup>.

<sup>7</sup> Kisielnicki J. - *Project Management. People - Procedures - Results*. Oficyna Wolters Kluwer Business, Warsaw 2011 (in polish), p. 15.

<sup>8</sup> PMBOK Guide - *A Guide to the Project Management Body of Knowledge*, Fourth Edition. Management Training & Development Center, Warszawa 2009, p. 10.

<sup>9</sup> Heldman K. - *PMP. Project Management Professional Exam. Study guide*. John Wiley & Sons, Inc., Indianapolis 2011, p. 8.

<sup>10</sup> MEANS Collection, Vol. 1 - *Evaluating socio-economic programmes*. Evaluation design and management, European Commission Structural Funds, Luxembourg 1999, p. 17.

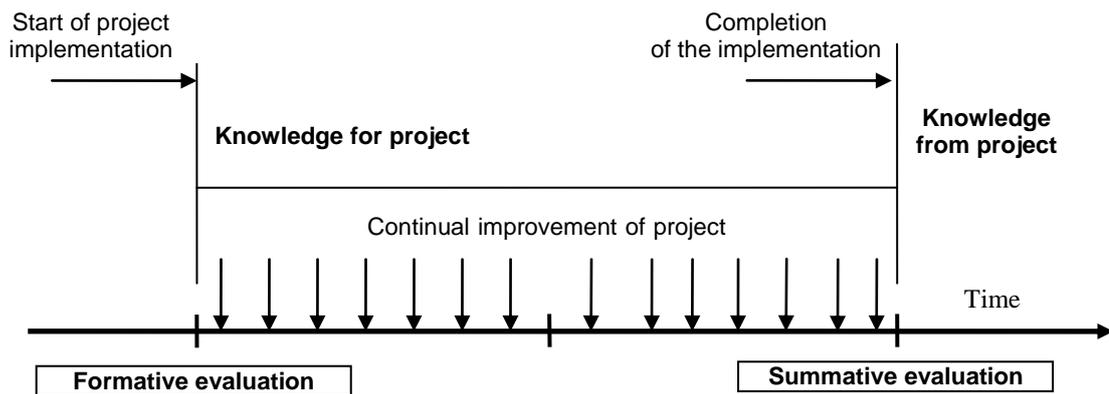


Figure 1. Types of evaluation and knowledge  
(source: own study)

An evaluation process should be implemented in an orderly and systematic way. The best-known definition of the evaluation has been formulated by M. Scriven. According to this definition evaluation is the systematic process. The aim of this process realisation is to achieve products in the form of the merit, worth or value of an object<sup>11</sup>. This systematic process should be realised on the basis of the required standards or criteria for judging the projects' performance<sup>12</sup>.

Evaluation research, which are carried out systematically, is useful not only in the case of the currently evaluated project and programme. M. Q. Patton paid attention to the fact that the results of systematically carried out evaluation research are often applied in the process of improving future projects and programs. Thus, it is necessary to collect information systematically about the activities and project results to make judgments about it. Not only does it enable to increase knowledge about the evaluated project but also favours improving further operations, developing project effectiveness and efficiency. It facilitates making up proper decisions about future programming<sup>13</sup>.

The project evaluation system should meet four basic principles: significant participations of stakeholders, impartiality and independence, credibility and transparency, usefulness – benefits from the results of the eval-

uation report. There are many kinds of these systems. They can be classified in a different way. The most evident is a classification from the point of view of time. Evaluation may be carried out before project realisation (ex-ante evaluation). Evaluation during the project (ongoing evaluation) and after finishing the project (ex-post evaluation) is also known.

The popular one is also a classification of evaluation from the point of view of its execution objectives. They may be cognitive and instrumental objectives. In the case of cognitive objectives, it is about the increase of possessed knowledge about the evaluated project. Then evaluation results may be used to work on similar projects. In turn, executing evaluation with instrumental objectives makes it possible to use its results, e.g. in the process of making decisions about project implementation.

Two other kinds of evaluation associated with instrumental objectives are also known. The first one is summative evaluation and it is used to support decision making about a completed project. This type of evaluation enables supporting decision making about, e.g. organisational changes, modifications leading to improvement of financial and economic efficiency and effectiveness etc. The second one is formative evaluation. It is connected with ex-ante evaluation and ongoing evaluation. Formative evaluation helps to improve a project and make a decision about beginning, continuing or ending a project. Different kinds of knowledge are connected with the types of evaluation mentioned above (Figure 1).

<sup>11</sup> Scriven M. - *Evaluation thesaurus*. Sage Publications, Inc., London 1991, p. 1.

<sup>12</sup> Rossi P. H., Lipsey M. W., Freeman H. E. - *Evaluation – A systematic approach*, Thousand Oaks, Sage Publications, Inc., CA 2004, p. 16.

<sup>13</sup> Patton M. Q. - *Qualitative Research & Evaluation Methods*. Thousand Oaks, SAGE Publications, Inc., London, New Delhi 2002, p. 10.

In the literature, various notions connected with knowledge management and project management are used. It can be, e.g. assumed that a superior role is played by all knowledge connected with projects planning and realisation. Knowledge from projects results from completed projects. Knowledge about project management concerns methods, techniques, tools and the best practises of project management. Knowledge in projects means possessed and desired sources of knowledge which are administered by project teams. Knowledge about projects is knowledge about a set of projects creating past, actual and future programs<sup>14</sup>.

According to the approach of D. Damm and M. Schindler, one should pay attention to considerations within the holistic view. In this view, three kinds of knowledge can be distinguished: about projects, in project and from projects. Knowledge about project results from skills management, measurement of controlling indicators, records of planning and control documents, projects marketing and designing of organisation structures. The sources of knowledge in projects are documentation, discussions effects, meeting repository and knowledge from information systems – PIM (Personal Information Manager), GIM (Geographic Information Management), etc. Knowledge from projects means learning from best practises/lessons learned<sup>15</sup>.

Similarly to classifications presented above a typology of evaluation can be presented. Evaluation knowledge is the most general term including total knowledge connected with project evaluation. Additionally, following kinds of knowledge connected with project evaluation can be distinguished. Knowledge about project evaluation is equivalent to meta-evaluation, which is assessment of evaluation process. Knowledge from project evaluation results from realisation of evaluation process. Knowledge in the project evaluation process concerns systems, methods and techniques of conducting project evaluation processes<sup>16</sup>.

In the project evaluation process the following things should be identified: key research questions, the meth-

odological strategies for answering these questions, criteria and indicators for project evaluation, research methods associated with various stages of the evaluation process and creating a system of methods for comprehensive evaluation project. The basic set of evaluation criteria including efficiency, effectiveness, relevance, sustainability and impact. These criteria are concretized for certain projects. They refer to social, economic, environmental, scientific, technological and other aspects. Thus, they have interdisciplinary and multidimensional character. Their proper consideration in evaluation research is possible to provide that modern ICT technologies are used. New methods based on knowledge should play an important part in evaluation methods.

### 3 Evaluation systems based on knowledge

In the introduction of this paper, research assumption is made that the essential condition of correct functioning of the comprehensive evaluation system is the application of modern concepts and methods which allow knowledge management. These new approaches to project evaluation can be a complement of classical evaluation methods within the multi-faceted hybrid system of methods (Figure 2). Development of new project evaluation methods based on knowledge should proceed simultaneously with research on classical evaluation methods.

Due to the dynamic development of ICT technology, it is quite easy to design and build information systems gathering knowledge, learning and supporting knowledge management. Such systems can learn, adapt and improve themselves, thanks to gained knowledge from empirical data which are learning examples. It is possible to discover knowledge and save it in knowledge bases which are the basic element of KBS (Knowledge-Based Systems). KBS are usually based on AI, machine learning and data mining methods. Among popular data mining methods, e.g. decision trees, neural networks<sup>17</sup>, genetic algorithms, fuzzy logic, rough set<sup>18</sup>, case-based reasoning, intelligent agents,

<sup>14</sup> Wyrozębski P. and others - *Study of Project Knowledge Management Practices in Polish Organizations* [in] Knowledge, Maturity and Risk in Project Management. Publishing House, Warsaw School of Economics, Warsaw 2012 (in polish), p. 55.

<sup>15</sup> Damm D., Schindler M. - *Security Issues of a Knowledge Medium for Distributed Project Work* [in] International Journal of Project Management, 20(2002), p. 40.

<sup>16</sup> Grzeszczyk T.A. - *Modeling Evaluation of European Projects*. Placet, Warszawa 2012 (in polish).

<sup>17</sup> Grzeszczyk T.A. - *Application of Neural Networks for Prior Appraisal of Structural Funds Project Proposals* [in] Seruca I., Filipe J., Hammoudi S., Cordeiro J. (ed.) - Enterprise Information Systems, Vol. 2., Portucalense University, Porto, Portugal 2004.

<sup>18</sup> Grzeszczyk T.A. - *Application of the Rough Set Method for Evaluation of Structural Funds Projects* [in] Manolopoulos Y., Filipe J., Constantopoulos P., Cordeiro J. (ed.) - Artificial Intelligence and Decision Support Systems. Paphos, Cyprus 2006.

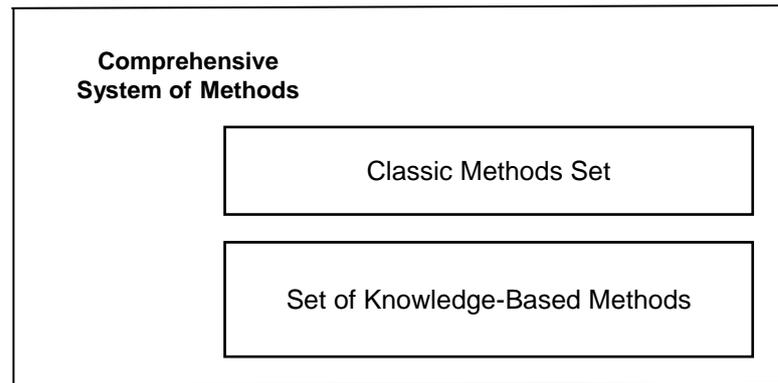


Figure 2. The multi-faceted hybrid system of methods  
(source: [7], p. 93)

if-then-else rules, association rules can be listed. KBS and so called intelligent systems function on the basis of a different type of knowledge: static and dynamic. The static knowledge refers to facts describing certain reality. It is so called declarative knowledge (aka descriptive knowledge, propositional knowledge). This dynamic knowledge enables to describe dynamics of occurring processes and it is procedural knowledge (aka imperative knowledge).

According to B. Stefanowicz, in the world of AI methods, three elements reflect procedural knowledge: algorithms, heuristics and analogies. These elements together with declarative knowledge create a basis for building a consistent model where the surrounding universe was best described<sup>19</sup>.

Knowledge can be stored in two forms: symbolic and non-symbolic. The symbolic form is usually used in knowledge-oriented systems. Knowledge is recorded there in the form of a certain kind of symbols which are understood in a specific way. An ordinary alphabet can be one of the symbols. Knowledge is then recorded by means of sentences readable to people. Thanks to this, such knowledge may be not only processed by computers in the process of machine learning but also read out and processed by people. The most known AI methods use symbolic knowledge in the following forms: association rules, decision rules, decision trees, lists, knowledge frames, semantic networks and object-attribute-value triplets.

The associations rule is one of several more known methods of data mining. This method is used to discover hidden patterns and potentially useful relations between variables in usually empirical data. Decision

rules are a symbolic representation of behaviour and knowledge of human experts. Decision trees apply to present the sequence of interrelated decisions and the expected results resulting from them. These results come out from choosing a certain way of acting. Changes of made decisions lead to the modification of decision trees<sup>20</sup>.

A crucial feature of symbolic knowledge representation methods is processing knowledge in a qualitative form. The way of representing knowledge usually enables relatively easy realisation of an interactive dialogue with the user of this kind of systems. The result of such a dialogue are offers of system concerning solving desirable problems, offers necessary to make decisions, etc. What is more important, this advice and suggested decisions may be, in a relatively simple way, justified. Yet, knowledge is recorded in a knowledge base in a symbolic form which is understood for the system user.

The most known way of saving knowledge in a readable and understood form for human is decision rules in the structure of 'if-then'. Quantitative and qualitative knowledge gained from experts evaluating projects is transformed to the form which enables its saving, processing and using<sup>21</sup>. This knowledge can be discovered also from data resulting from surveys conducted among project stakeholders.

Knowledge that is stored in the if-then rules can be of an important significance in the processes. Project management is often gamed through experiential learning. These rules are pieces of knowledge about project

<sup>19</sup> Stefanowicz B. - *Algorithms. Heuristics. Analogies* [in] Statistical News, 3/2012 (in polish), p. 77.

<sup>20</sup> Heldman K. - *PMP. Project Management Professional Exam. Study guide*. John Wiley & Sons, Inc., Indianapolis 2011, pp. 265-266.

<sup>21</sup> Grzeszczyk T.A. - *Modeling Evaluation of European Projects*. Placet, Warszawa 2012 (in polish).

management and evaluation. Rules of thumb (heuristics) can be in the form of anecdotes, best practises, lessons learned, experimental rules, guidelines, cases etc.<sup>22</sup> Machine learning and data mining methods allow to obtain such rules through the use of computer systems.

Machine learning methods enable to formulate algorithms useful for discovering knowledge saved in the knowledge base built from induced decision rules received from expert knowledge. Learning examples are projects evaluated before. Decision rules are induced when using one of selected algorithms of machine learning. Generally, using machine learning system consists in inducing decision rules and looking for such rules which enable classification.

Decision rules are generated from examples, so called learning objects of known classifications. These rules are induced in order to use them to classify new objects. In the case of associations' rules, the process of discovering knowledge happens without learning examples. The associations rule has the following conditional form (if A then B):  $A \rightarrow B$ . A sentence implies B sentence. Sentence is a set of attributes.

Thanks to the use of associations' rules, it is possible to discover knowledge which is not accessible directly. Knowledge discovery means quantitative and qualitative analysis. The qualitative analysis which consists in finding relationships, correlations, patterns and useful knowledge in an analysed data sets is particularly important. Significant usefulness of this kind of solutions results from the possibility of relatively easy implementation of the evaluation system based on knowledge on the basis of a defined concept.

#### 4 Concept of a new evaluation system based on knowledge

Resources necessary for planning and implementation of projects are becoming more difficult to reach. So, it is important to make reasonable distribution of resources, which are allocated for projects execution. We can see an arising problem in evaluating projects in a proper way. An important assumption is for the projects to solve certain problems consistent with stakeholders' needs and expectations. Project objec-

tives, evaluation indicators and criteria ought to be formulated in consultation with stakeholders.

Therefore, surveying opinions of project stakeholders is very significant in the process of evaluation. No matter what evaluation method was chosen, stakeholders analysis should not be ignored. This analysis can be carried out as an independent evaluation tool or as a part of complex evaluation methods. For example, stakeholder analysis is the first step in Analysis phase and Problem analysis<sup>23</sup> which were performed in accordance with the Logical Framework Approach (Figure 3).

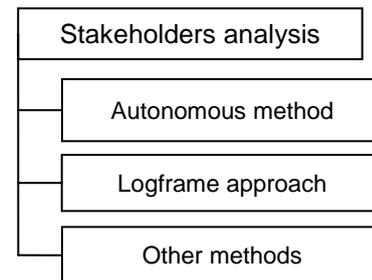


Figure 3. The importance of stakeholders analysis in project evaluation systems  
(source: own study)

In evaluation systems, except classical approaches, new methods should be researched. According to increasing uncertainty, unpredictability and irregularity in organisation's environment we should also use approaches better suited to conditions of turbulences and unpredicted changes. This kind of approaches are based on AI methods, knowledge management and knowledge technologies. In this conditions, evaluation systems should be based on knowledge and project stakeholders' needs and expectations. Modelling should be supported by chosen system approaches, concepts connected with knowledge management and methodology of management sciences. The principle of primacy of learning process over static use of knowledge resources should be engaged.

Modelling evaluation systems need to be aware of complex, multidimensional and turbulent reality. The one of the most important things about solving evaluation problems is their quality nature. Quantitative methods are less taken into consideration. It is needed to search for qualitative computer methods based on knowledge, modern mathematical instruments

<sup>22</sup> Liebowitz J. - *Conceptualizing and implementing knowledge management* [in] Love P., Fong P., Irani Z. (eds.) - *Management of Knowledge in Project Environments*. Routledge, 2005, p. 5.

<sup>23</sup> Grzeszczyk T.A. - *Evaluation of European Projects 2007-2013*. Placet, Warszawa 2009 (in polish).

and algorithms for discovering rules in the collections of data which are referring to project stakeholders.

Applied algorithms and computer methods in a model of project evaluation system should enable to take various, quantitative and qualitative evaluation criteria into account.

Evaluation criteria may refer to economic, social, environmental, legal and other aspects. According to that, modelled evaluation system should include different types of evaluation criteria. It provides an opportunity to evaluate various types of projects, which are related to specific criteria. Evaluation system's flexibility in the selection of different evaluation criteria means universality of the developed solutions. This versatility may also be associated with the suitability of the system for use in formative and summative evaluation processes.

Among many general assumptions of project evaluation system the following foundations should be considered as the most important ones. This system is an universal evaluation tool of different kinds of projects and ease of modification of the range and kind of executed evaluation process. In modelling process the multidisciplinary system approach to project evaluation is used. Evaluation system should make it possible to analyse surveys conducted among project stakeholders. It should ensure easy implementation taking criteria

desirable by the system user into consideration. The system ought to provide possibility of using quantitative and qualitative evaluation criteria. Modelled evaluation system should include quantitative and qualitative results of project stakeholders' analysis.

In the evaluation process, we can often notice the lack of well-defined knowledge, which would provide perfectly reliable fundamentals for solving a decision problem. The designed solutions should provide solving evaluation problems even if data is unsuitable for solving a problem with classical statistical methods. Evaluation system needs to work properly with uncertain, incomplete and inconsistent input data. It is essential to ensure possibility of using different statistical, data mining and AI methods. Evaluation system ought to provide clear graphic visualisation of the project evaluation results.

Proposed project evaluation approach supported by association rule base is shown in Figure 4. The first step is to conduct surveys with project stakeholders. In the next stage data preprocessing is made, the aim of this is to adjust available survey results to the computer system. According to the assumptions adopted earlier, it is essential to ensure a possibility of using different statistical, data mining and AI methods. In order to limit study area, it was decided to use data mining algorithm for generating association rules.

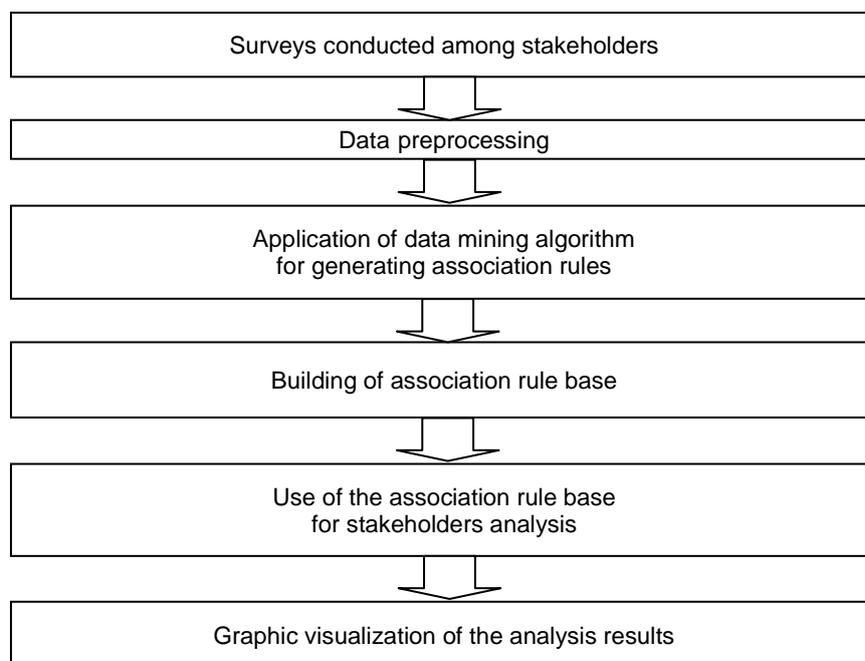


Figure 4. Proposed project evaluation approach  
(source: own study)

The results which are the effect of computer calculations are the foundation for building association rule base. The software works in accordance with adopted algorithm. Then, we can use this base in the stakeholder analysis process. The last stage of the proposed project evaluation approach is graphic visualisation of the analysis results. This graphical visualisation makes it easier to interpret the results and increases the practical utility of this evaluation system.

The evaluation system concept has led to the realisation of an exemplary implementation of this kind of system. Experiments results are shown in the next section of this paper.

## 5 The example of using association rule base for project stakeholders analysis

The example of evaluation system based on knowledge refers to building knowledge-base useful in the stakeholder analysis process. This type of analysis was selected because of its great importance in project evaluation practise.

Surveys which are conducted among stakeholders are used in the empirical verification of proposed project evaluation approach. Interviewees are potentially associated with the public project for the protection of local community health. Survey was carried out among stakeholders from the Podlaskie Voivodeship (mainly from the area of the town of Lomza). In the study, there are included 150 records in data set. The results from this research should not be considered as representative sample of entire population. The data is hypothetical and helpful in illustrating only the proposed system.

In accordance with previously formulated concept of a new evaluation system based on knowledge, such empirical research may be performed in the following steps. In order to conduct surveys among project stakeholders, it is recommended to (if possible) precisely define community from which stakeholders come from. Evaluators should also prepare a set of questions in the questionnaires addressed to them. The most comfortable questionnaires are in the electronic version. It is possible to send them to all respondents. These surveys provide data for further processing using the selected data mining algorithm.

According to the conception formulated in the previous section of this paper, the next step is data preprocessing. After completing this step, the results of the survey are useful for processing by a computer pro-

gramme which is in accordance with the algorithm for generating association rules. Exemplary implementation of the project evaluation system was realised with the use of software StatSoftStatistica 10.

Opinions on public health services were researched in the following scale:

- 1 – Poor
- 2 – Fair
- 3 – Good
- 4 – Excellent

The survey included five most pressing local health problems:

- 1 – Alcohol abuse,
- 2 – Cancer,
- 3 – Depression,
- 4 – Obesity,
- 5 – Smoking.

Three following barriers to health improvement were taken into account:

- 1 – MTE – Medication Too Expensive,
- 2 – DAS – Difficult Access to Specialists,
- 3 – TAP – Toxic Air Pollution.

Hereafter presented the analysis results of the five most pressing local health problems. These problems are recorded in the data file as multiple response variables. That was five possible answers from which project stakeholders have to choose.

Gender saved such us dichotomy variable – dichotomous data: Male and Female. From the data file made rules about associations. For identifying these rules uses the a-priori algorithm<sup>24</sup>. This algorithm required a user-defined threshold values for process of rule generation – minimum: support, confidence and correlation. Assume the following values:

- support – 30%,
- confidence – 70%,
- correlation – 50%.

Basing on calculations with using data mining software author has built association rule base, which has, afterwards, used for stakeholders analysis. The results of this analysis are available in at least two forms: legible association rules and graphic visualisation.

<sup>24</sup> The a-priori algorithm is implemented in Statistica software. Agrawal R., Srikant R. - Fast Algorithms for Mining Association Rules [at] International Conference Proceedings. VLDB'94 - Very Large Data Bases. Morgan Kaufmann, California 1994, pp. 487–499.

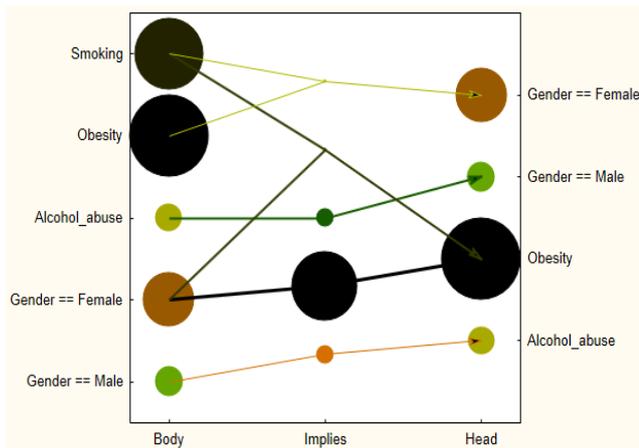


Figure 5. Association rules network (source: own study)

Figure 5 presents this kind of graphic visualisation (2D version). Visualization confirms the practical utility of the proposed solutions.

The major association rules are shown in Table 1. On the basis of the analysis of these rules useful conclusions can be drawn. For example, men living in the local area see mostly alcohol abuse problem and women – obesity. With the problem being noticed by women – obesity, associates second health risks. It is smoking. This kind of women response may have been probably the result of generalised opinion that quitting smoking causes weight gain.

Table 1. Summary of association rules (source: own study)

	<b>If Body then Head</b>	<b>Support [%]</b>	<b>Confidence [%]</b>	<b>Correlation [%]</b>
1	If Gender = Male then Alcohol abuse	34.67	78.79	79.39
2	If Gender = Female then Obesity	48.00	85.71	76.67
3	If Alcohol abuse then Gender = Male	34.67	80.00	79.39
4	If Gender = Female and Smoking then Obesity	30.67	82.14	59.99
5	Obesity and Smoking then Gender = Female	30.67	74.19	63.74

The results obtained in the form of legible association rules and graphic visualization can provide a reliable basis, e.g. for the evaluation of conformity accomplished health protection programs to the needs of the local community. They are also useful in development of strategies based on the identified health needs, initial stages of defining public programs objectives and programs priorities formulating. Later proposed projects which solve chosen problems may be better suited to the residents’ of the local communities real health needs.

## 6 Summary and conclusions

The presented example of knowledge-base for project evaluation has turned to be useful in practical applications. As a result of computer calculations, results were obtained in two forms: readable association rules and graphic visualization. They are simple to understand and interpret. Easy to formulate conclusions result from rules and they can be additionally illustrated thanks to 2D and 3D graphic visualizations.

Solutions proposed in this study may seem to be complicated for evaluators without technical education.

But they are not. Complex data mining algorithms are available in quite a simple way. There is no need to require extensive knowledge in ICT technology from members of evaluation team carrying out this kind of stakeholders analysis. Working with software used to calculations and analysis is intuitive, and necessary defining of parameters is limited to minimum.

Research which is carried out currently refer to the author’s previous works looking for new evaluation methods whose creation results from development of new ITC technologies. These researches are based on inspirations resulting from a present state of knowledge in modern management theories and practises. Using systems thinking enables development of evaluation systems toward comprehensive solutions. New project evaluation methods based on knowledge together with classical approaches can be found useful in the modelling process of a comprehensive evaluation system.

On the basis of knowledge methods which enable to increase the number of evaluation methods used in comprehensive evaluation systems. They can be used to solve problems which are difficult to apply in classi-

cal evaluation methods. These methods are very suitable to solve reasoning problems under the conditions of uncertainty. Empirical data are usually uncertain, blurred and fuzzy. That is why it is difficult to present them in a numeric form.

Empirical information and knowledge can be unreliable, imprecise and incomplete. Methods based on a strict and precise mathematical description of a complex project situation have lesser and lesser significance in the evaluation process. Thus, these phenomena are, most of all, of a qualitative character. In this context one has great hopes of conducting interdisciplinary research on application of selected new ICT technologies and AI methods in comprehensive evaluation.

Research results, which are connected with formulating a concept, realising experimental implementation and verifying the solution proposed in this article are promising. These researches should require to be continued. It is necessary to work out theoretical basis of a model of evaluation system and formulate its formalised definition. This formalised description enables to formulate next experimental model implementations and further practical research connected with applications of proposed solutions.

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## MANAGEMENT OF RECEIVABLES ON THE EXAMPLE OF BUSINESS ENTITIES FROM THE PŁOCK SUBREGION

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**Abstract:** The article presents a problem and differences of financial liquidity and profitability. The survey of financial liquidity and profitability, underwritten by the College of Economics and Social Sciences of Warsaw University of Technology, was conducted on Płock Subregion enterprises. The survey concerned cash flow management, receivables controlling, trade credits, different payments and receivables. The results of the conducted survey indicate that the majority of companies from the subregion of Płock suffer several problems and despite a wide range of possibilities of using different tools for the management of receivables, the respondents do not use them efficiently. The survey has shown that most of them applies only the most popular, simplest and cheapest solutions, but, consequently the least efficient.

**Key words:** financial liquidity, profitability, subregion of Płock.

*One must choose in life  
between making money and spending it.  
There's no time to do both.*  
Eduard Bourdet

### 1 Introduction

Proper functioning of business entities in a market economy is a determinant of a variety of both internal and external factors. Modern market economy is based on entities operating on the market, the effects of which are mutual settlements of accounts of the participants of the economic exchange. Together with deferred payments appear accounts receivable.

One of the fundamental areas responsible for the security of an entity is the size of the sales that constitutes a source of monetary proceeds. Today, however, the mere sales are insufficient.

Efficient and successful management of receivables is one of the most important tasks that a business enterprise must realise. Beside from actions related to receiving a trade credit, they should also be related to the price discount policy applied by the company and the extent of utilisation of the tools for the management of receivables. We need to remember that even a short-term cash deficit may have a negative impact on the existence and position of the entity on the market. All financial decisions should focus on the efficiency of the cash flow and its effective utilisation. The need to maintain cash flow, conditioned by the level of financial resources and the possibilities of their obtain-

ment, has become a very significant issue in the Polish economy.

The aim of this study is to analysis the utilisation of the available tools for the management of receivables on the example of the Płock subregion with particular focus on the scale of overdue payments, reasons for their occurrence and methods of prevention.

### 2 Receivables vs. trade credit

A receivable, because of the conducted economic activity, is a debtor's responsibility towards the creditor that should be satisfied in a specified term and amount. A receivable is most often perceived as a right of an entity to receive money from another entity. This however has to be analysed from the financial, legal and accounting points of view (see Fig. 1)<sup>1</sup>.

Accounts receivable is an important component of the entity's balance sheet and its control should be an important element of the entity's operation strategy. A trade credit, the result of which is a receivable, is necessary if we want to conduct economic activity. It has impact on the sales growth and, consequently, ensures company's development.

<sup>1</sup> K. Kreczmańska-Gigol - *Windykacja należności*. Difin, Warsaw 2011, p. 25.

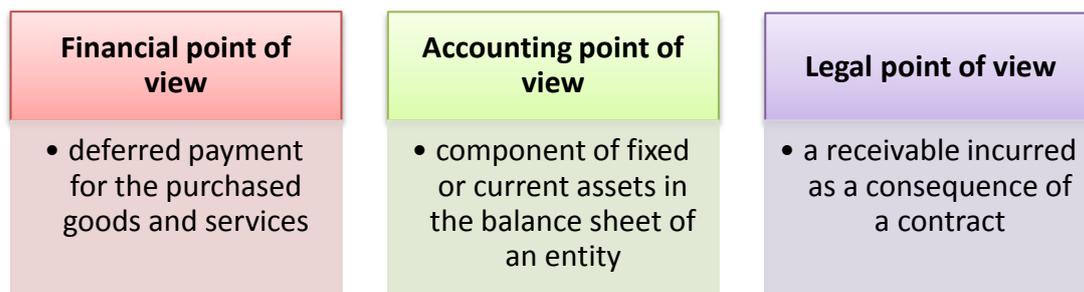


Figure 1. Points of view on the receivables  
(source: own research)

The control of the receivables is tightly related to the strategy of cash flow that determines the possibility of taking a credit by the company, its' terms and conditions as well as the possibility of crediting the recipients of goods and services. To exist on the market, an entrepreneur must carefully control his cash flow, which is part of the management of receivables. Receivables should undergo a constant and regular evaluation. The control of the receivables depends on many factors that condition an efficient operation of business entities. The consequence of a surge in the level of receivables is an increase in the demand for net working capital and a growth in the risk of overdue receivables and, hence difficulties with timely payments.

Cash flow management is a decision-making process, whose effect is incoming and outgoing cash in a business entity. The success or failure of an enterprise depends on the efficiency of this area, as the company's solvency is a condition for its presence on the market. Insufficient liquidity will mean serious consequences for the entity and consequently may lead to bankruptcy.

On the other hand, however, in the end, the existence of a business entity is impossible without appropriate profitability<sup>2</sup>. The profit constitutes a source of the company's growth of assets and capital, thus adding to the value of the company and securing benefits for the owners. Yet, today, the mere profitability is not tantamount to having monetary means allowing timely payments.

Profit is a result of the company's achievements and is a source of financing of the business development, but it is the liquidity that determines the real possibilities of financing. It also constitutes a basis for future profitability. Maintaining financial liquidity is treated as

a strict by-condition for profitability<sup>3</sup>, whose failure to meet results in the elimination of a player from the market game. The struggle for profitability must be realised securing the financial liquidity. Profitability does not guarantee liquidity and the lack of profitability does not have to mean problems with timely payments.

Maintaining liquidity is a short-term objective of the company activity, so that in the end the owners equity and the value of the enterprise could be multiplied<sup>4</sup> and constitute secure foundations for development.

The essence of liquidity is expressed in the words of Wojciech Topolnicki in 2009, vice-president for development and finance of Polska Grupa Energetyczna (Polish Energy Group) during a debate by 'Rzeczpospolita': 'Company financing in the time of crisis'<sup>5</sup>: '(...) I agree that today it is not so much the profit margin that is important but access to cash, financing. If we don't have liquidity, you go bust. It does not matter that we have a great portfolio and many clients waiting for our products. If you do not have cash these days you must go bankrupt.'

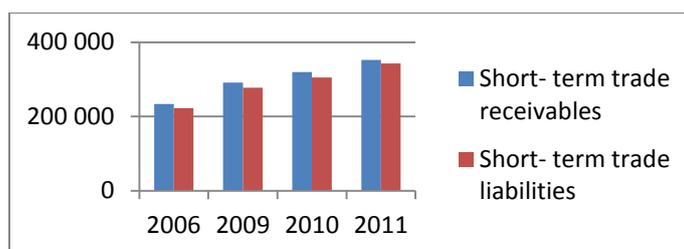
Today the sales with a deferred payment are a natural thing, resulting from both the client expectations and standards in the business. Trade credit is a source of financing the business activity. It facilitates securing new clients and allows maintaining collaboration with the existing ones.

<sup>2</sup> Sierpińska M., Wędzki D. - *Zarządzanie płynnością finansową w przedsiębiorstwie*. PWN, Warsaw 2005, p. 7.

<sup>3</sup> Waśniewski T., W. Skoczylas W. - *Teoria i praktyka analizy finansowej przedsiębiorstwa* [in] Fundacja Rozwoju Rachunkowości w Polsce, Warsaw 2002, p. 431.

<sup>4</sup> Sierpińska M., Wędzki D. - *Zarządzanie płynnością ...*, op. cit., p. 11.

<sup>5</sup> Fandrejewska A., Krześniak M. - *Jak rozruszać kredyt* [in] *Rzeczpospolita*, 1.07.2009, pp. B7-B8.



Graph 1. Trade receivables and liabilities in Polish non-financial enterprises in millions of plz  
(source: Own source based on *Balance Sheet Financial Results of Business Entities* by (GUS, 2006–2011))

This also means certain inconveniences for the seller. It brings a variety of unknowns, the most important of which is the risk of overdue payments, which may increase the costs of financing and management of receivables. Deferred payment is very often an alternative to bank loans whose approval is dependent upon a positive verification based on bank procedures.

Relevant literature distinguishes two patterns related to a trade credit. In the financial aspect, it is a source of financing that is an alternative to a bank loan. The conducted research confirms the increasing role of a trade credit in the situation of limited access to external financing<sup>6</sup>. The supplier, owing to an established collaboration with a business partner, can monitor changes in his financial situation, which gives him an information advantage over a financial middleman<sup>7</sup>.

According to a market pattern, trade credit is a resultant of the number of transactions and size of the sales. It allows a reduction of the transaction costs and costs related to the maintenance of the finished products. It also allows the application of flexible pricing policies and improves cash flow management.

The phenomenon of a substitution of trade credit for a bank loan is more frequent in small business entities, irrespective of the business sector of operation<sup>8</sup>.

Receivables play an important role in supporting the sales. Their level is a resultant of the policy of recipient crediting by the entity, whose aim is to maximise the sales at an acceptable level of risk. The significance of receivables for the Polish economy is shown in Graph 1.

The analysis of data provided by Główny Urząd Statystyczny (National Office for Statistics) indicates a constant growth in the level of receivables being a result of trade credits. In 2011 these increased by 10% as compared to the previous year but in comparison to 2006 this was already a 50% growth. The analysis of the structure of assets of Polish enterprises based on the data from 2011 indicates a high share of short-term trade receivables in the balance sheet. They constituted 15% of the assets. Their share in the current assets already amounted to 36%.

Trade credit is currently treated as an important element of the trade policy, determining the level of market competitiveness.

The competitive potential depends on many factors<sup>9</sup> such as: market share, cost efficiency, image, technological skills and technological level, level of organisation and management, profitability and financial policy of an enterprise. In order to ensure the above, the following are important: reputation, time of completion of an order, accessibility to materials, flexibility and adaptability to the client requirements, knowledge and competence of the employees, innovativeness, information resources and many other. The approval of a credit (that may become a trade credit) frequently becomes a competitive advantage<sup>10</sup>. Trade credit is perceived as an element of the competition frequently used by the recipients whose bank creditworthiness is insufficient or who are deterred by the complexity of the bank procedures or the required security.

The length of the payment deferral and the relevant terms and conditions, particularly in small businesses, may constitute a tool modifying the demand resulting in an increase in the sales and reinforcing of the posi-

<sup>6</sup> Por. Petersen M., Rajan R. - *Trade credit, theories and evidence* [in] *Review of financial Studies* 10(3), 1997, p. 661.

<sup>7</sup> Wasilewski W. - *A Total Risk Assessment in an Enterprise* [in] *Foundations of Management*, Vol. 04, No. 02(8), 2012.

<sup>8</sup> Marzec J., Pawłowska M. - *Substytucja między kredytem kupieckim i bankowym w polskich przedsiębiorstwach* [in] *Bank i Kredyt*, 43(6), 2012, p.45

<sup>9</sup> Gierszewska G., Romanowska M. - *Analiza strategiczna przedsiębiorstwa*. PWE, Warsaw 2009, p. 129.

<sup>10</sup> Bień W. - *Problemy efektywnej sprzedaży na kredyt* [in] *Zarządzanie majątkiem obrotowym w przedsiębiorstwie*, red. J. Grzywacz, SGH, Warsaw 2006, p. 77.

tion on the market. This tool is of particular importance for entities in the initial phase of development or those that are seeking markets for new products or services. Large enterprises of established market position frequently impose on clients short and only slightly negotiable deferrals of payment<sup>11</sup>.

We need to note that the decision on approving a trade credit cannot be made independently without consultation. Its terms depend on the decision taken in other areas and the consequences are interrelated. It does happen sometimes that local objectives of individual departments are in opposition to the global tasks in other areas of activity or even to the strategic objective of the company. The supplies departments aim at maintaining a high level of goods in stock in order to ensure the continuity of production, not minding the related costs. The key to success and maintaining equilibrium is the postulate stressed in logistics related to a complex judgement of the activity and evaluation of the purposefulness of individual actions from the point of view of the main objective.

When we decide to give our clients a trade credit, we need to strictly adhere to the adopted strategy related to the compromise between the acceptable risk and the plans to boost the sales. We may distinguish a conservative strategy of the lowest risk level and the lowest sales growth quotas, moderate strategy and aggressive strategy that assumes a boost in the sales level but also accepts the highest level of risk. In order to protect the business against the risk of losing financial liquidity, we must not let the amount of receivables exceed the sources of refinancing of the liabilities of his debtors available to the supplier<sup>12</sup>.

There are measurable and immeasurable benefits that are suggestive of creating receivables, thus allowing deferred payments. This allows an increase of the sales by securing new clients. This may result in a more effective use of the production capacity, which directly translates into the cost level. Offering a deferred payment to clients also allows collaboration with clients having a temporary cash deficit. This also means liquidation of stock, which again translates to measurable financial benefits related to the reduction of the costs of stock keeping, its wear or loss of value.

### 3 Overdue Receivables

The management of receivables is a wider term than the receivables themselves. This pertains to actions related to the trade policy towards the recipients, the principles of approving of a trade credit, its size and limits or the amount of possible discounts. It covers processes that influence the level of receivables but it goes a bit further and should not be identified with the mere control or monitoring of receivables. As the payment morality of companies deteriorates, payment backlogs intensify and management of receivables becomes increasingly important. The main objective of the management of receivables is the attempt to reduce the unsettled payment, maintain continuity in the cash flow and maintain positive relations with the clients.

The efficiency in the management of receivables is tightly correlated with the strategy of financing of the contractors and it can be measured with the index of the share of overdue receivables being the consequence of approved trade credits.

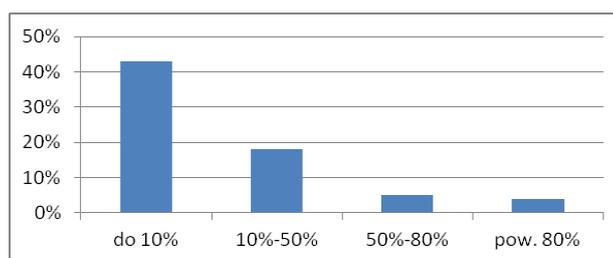
Untimely settlement of accounts is a serious problem for the managers of receivables. This is confirmed by periodical surveys by BIG Infomonitor<sup>13</sup>, where 80% of the companies admitted that untimely payments were a serious obstacle in conducting business operations. It is noteworthy however that we are observing an improvement and within the last three months, the number of companies treating untimely payments as incidental grew by 3 %.

Besides, the last report confirmed that 64% of the companies positively evaluated their contractors in terms of their financial liquidity. For over a year now the group of companies receiving 90% of their payments without any delay has been growing. In March, the percentage of such companies was 16% and today the group has grown to 21%. There is still, however, a group of entities confirming the existence of overdue receivables. From the group of companies 46% of the respondents declared delayed payments exceeding the amount of plz 100.000 while three months earlier this share was 13% lower.

<sup>11</sup> Seretny M., Seretny A. - *Sustainable marketing - a new era in the responsible marketing development* [in] Foundations of Management, Vol. 04, No. 02(8), 2012.

<sup>12</sup> W. Bień, - *Problemy ...*, op. cit., s. 85.

<sup>13</sup> The report of BIG (Consumer Reporting Agency) - *The index of security of business transactions* [in] BIG Infomonitor. Warsaw, September 2013, p. 9.



Graph 2. Percentage share of overdue receivables  
(source: own research)

Table 1. Percentage of overdue payments  
(source: based on own studies)

Period of overdue payments of Polish enterprises	Percentage of overdue payments of Polish enterprises
Up to 1 month	41%
From 1 to 3 months	23%
More than 3 months	5%

This fact is also confirmed by the surveys performed on a group of entities from the subregion of Płock. The majority of companies from the subregion of Płock<sup>14</sup> declared deferral of payment for their contractors on the level not exceeding 45 days. Over 60% of the companies estimated that up to 50% of their receivables had not been settled in time (Graph 2). Timely payments were declared by over 30% of the respondents.

In the group of all the respondents 43% estimated that the share of untimely payments did not exceed 10% of the total receivables. The majority of the respondents confirmed issues with timely payments. Every third invoice was paid with a delay of up to one month and for another 20% the delay was from one to three months.

It is also noteworthy that despite a high percentage of the indications of untimely payments half of the entities declared timely payments of their own liabilities to the suppliers. If the payment reliability level were as good as the respondents declared the payment backlogs would not be such frequently indicated obstacle in the economic operations.

For a group of 41% entities the delay in the received payments did not exceed one month. For 23% of the

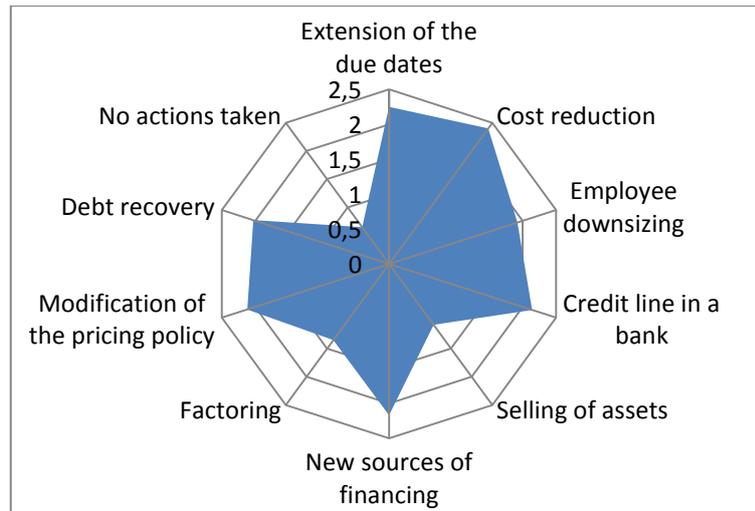
companies the overdue receivables were collected after at least one month from the due date, but the delay did not exceed three months. A detailed distribution of untimely payments has been shown in Table 1.

The results of the conducted survey indicate that the prevailing receivables were those 3 months in arrears while the share of receivables more than 3 months in arrears did not exceed 5%.

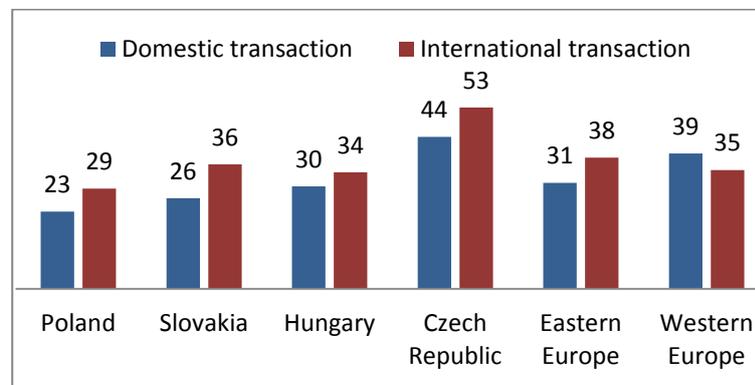
Delayed payments have become a common thing recently. The greatest risk came not from the fact of their mere presence but the fact that these actions were intended. The entrepreneurs intentionally took advantage of the rare instances of charging default interest and applied the policy of payment delays. Instances of warranty claims have also been recorded with a view to delaying the payment. This trend was particularly commonplace in the building sector where the long investment process and the engagement of many entities facilitated the extension of the times when the payments were made.

The analysis of responses related to the actions taken if arrears in payment occurred indicates several main and preferred solutions (Graph 3). These were: cost reduction, extension of the payment time of own liabilities to own suppliers and seeking new sources of financing. The respondents often considered changing the realised pricing policy. The authors also observed that debt recovery was gaining in significance.

<sup>14</sup> Survey conducted in the beginning of 2013 on a group of 95 companies from Płock, the Płocki Powiat and the surrounding Poviats.



Graph 3. Actions taken if arrears occurred  
(source: based on own research)



Graph 4.: Average duration of given trade credits in days  
(source: Own studies based on: Atradius Payment Practices Barometr, June 2012, Atradius, p. 11)

#### 4 The problem of payment backlogs

Another risk when conducting economic activity is the problem of payment backlogs. A helpful tool when collecting overdue payments may be continuous monitoring of the receivables thus improving the efficiency of debt recovery. If we consider proactive behaviour as a tool, the entrepreneurs could focus their attention on checking the credibility of their present or future contractors.<sup>15</sup> Checking the clients credibility prior to signing a contract would eliminate the risk of entering into collaboration with an unreliable payer or would enable taking precautions and adapt the security of a receivable ascribed to a given transaction, thus improving the safety of the deal.

The problem is not confined to the Polish economy – it reaches much farther.

The problem of overdue receivables for goods and services is observed in the majority of countries. The list of average number of days of payment of receivables offered to clients in 2012, in selected countries has been shown in Graph 4.

A disadvantageous phenomenon however was the change in the structure of the receivables in terms of the actual number of days prior to payment. An increase in the share of the longest payment delay was over 90 days. This may mean that a part of the delayed payments will most likely become overdue payments or even bad debts. For an entity, it means additional costs of debt recovery or legal action and sometimes it is simply treating the entire overdue payment as financial loss.

<sup>15</sup> Rzeszutek E. - *Holding groups: a safe corporate structure at the time of recession* [in] Foundations of Management, Vol. 04, No 02(8), 2012.

Table 2. Delayed payments

(source: own studies based on: *Atradius Payment Practices Barometr*, June 2012, Atradius, p. 16)

		<b>Up to 30 days</b>	<b>From 30 to 90 days</b>	<b>In excess of 90 days</b>
Poland	Domestic transactions	71.7%	23.0%	5.3%
	International transactions	70.6%	22.2%	7.2%
Slovakia	Domestic transactions	73.2%	23.8%	3.9%
	International transactions	80.5%	18.3%	1.2%
Hungary	Domestic transactions	71.7%	24.2%	4.1%
	International transactions	87.0%	11.4%	1.7%
Czech Republic	Domestic transactions	76.9%	19.0%	4.1%
	International transactions	79.8%	16.1%	4.1%
<b>Eastern Europe</b>	Domestic transactions	<b>73.5%</b>	<b>22.1%</b>	<b>4.4%</b>
	International transactions	<b>77.9%</b>	<b>18.5%</b>	<b>3.6%</b>
<b>Western Europe</b>	Domestic transactions	<b>68.3%</b>	<b>25.7%</b>	<b>6.0%</b>
	International transactions	<b>69.5%</b>	<b>25.2%</b>	<b>5.3%</b>

It is also necessary to pay attention to delayed payments that are becoming commonplace these days (Table 2). It is estimated that in Europe 1/3 of the values of the invoices for both domestic and international transactions are overdue payments and the actual time of receiving the payment in 2011 for Europe was 52 days

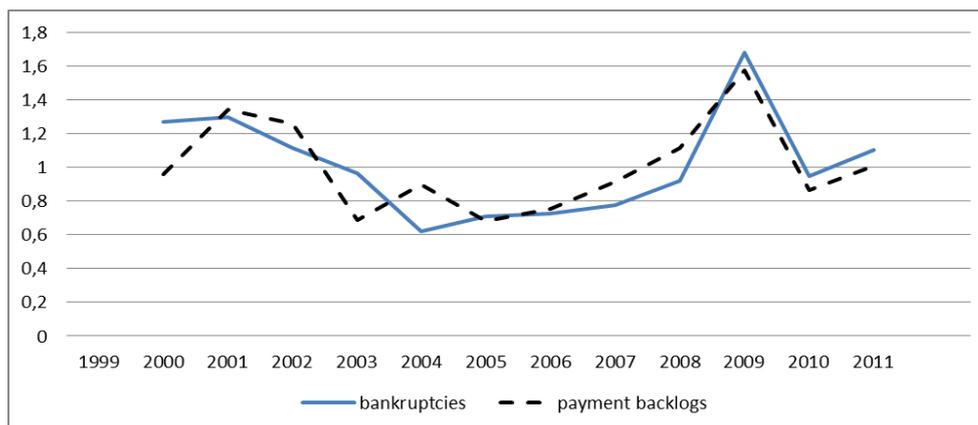
The approval of any trade credit is a risk of a delayed payment or no payment at all. As a result, the intensification of the 'chain of delayed payments' may turn out to be a peril for the entire economy. A survey by Atradius in 2012 indicated that in the Eastern Europe 2.6% of the value of receivables generated in the transactions realised on a domestic market were bad debts<sup>16</sup>. In the international transactions, this average was 1.8%. The highest percentage of bad debts was unfortunately recorded in Poland, where 4.4% of the value of the domestic receivables could be deemed irrecoverable. For the international transactions, it was not much lower and amounted to 4.1%. The best result was recorded for Hungary where as little as 1.7 % of the domestic and 0.6% of the international receivables were deemed irrecoverable.

Very often, a failure to pay on time is not the exclusive responsibility of the debtor, who actually got into trouble because of his suppliers failing to satisfy their debts. Payment backlogs and their negative consequences for the safety of the economic activity in particular were also noticed by the respondents. Over 30% of the entities from the Płock subregion perceived these backlogs as one of the main reasons for bad economic situation.

This was confirmed by the group of entities participating in the survey carried out periodically by NBP (National Bank of Poland) indicating an intensification of this phenomenon in the Polish economy. The evaluation of the bad situation of the recipients as an obstacle in the economic development, conducted since 2004, in both the value of the respondents' indications and the changing trends was convergent with the values recorded for payment backlogs<sup>17</sup>. Until the end of 2005 in the study on the obstacles the problem of payment backlogs and recovery of debts and the problem maintaining financial liquidity were distinguished as separate. From the first quarter of 2006, however these were joined for a single evaluation. Characteristic was also certain cyclicality in the consequences of the payment backlogs.

<sup>16</sup> Por. *Payment Practices Barometer. Survey of Payment Behaviour of Central and Eastern Europe*, Atradius, May 2008 and *Payment Practices Barometer. Survey of Payment Behaviour of European Companies*, Atradius, Winter 2008/2009.

<sup>17</sup> Preliminary information on the condition of enterprises with particular attention focused on the economic situation, NBP, 2004-2011



Graph 5. Dynamics of the phenomenon of payment backlogs and the number of bankruptcies in Poland  
(source: Own studies based on NBP (National Bank of Poland) data on the scale of the phenomenon of payment backlogs and Coface reports on the number of bankruptcies in Poland)

The related phenomena of payment backlogs and the number of bankruptcies have been shown in Graph 5.

Currently, an increase in the significance of payment backlogs is observed. The problem of untimely payments and their consequences for the economic activity of enterprises was most prominent in the second quarter of 2002 when this index reached a peak value of 20.1% of the respondents' indications. Starting from the subsequent quarter and for the entire following year the problems with debt recovery and related payment backlogs were on the second position among the obstacles in the development of business activity, as indicated by the respondents. It is noteworthy that the problem of payment backlogs is not only the consequence of the economic crisis but it has been in the Polish economy for quite a long time.

Already in 2001 Arkadiusz Protas, member of the Board of Business Center Club said: *'payment backlogs contribute to the bankruptcies of approximately 200.000 business per annum in our country'*<sup>18</sup>. Then, it was estimated that 30%–50% of the manufacturers have to wait for the payment from three to six months and it did happen that entities only succeeded in settling their accounts in excess of this period<sup>19</sup>.

Payment backlogs have been an issue in the economy for a long time. The crisis only contributed to the intensification of this problem. The main reason for the occurrence of this phenomenon is the deterioration of the payment morality of business entities and too expansive policies towards the clients such as extend-

ing of the due dates. This would be nothing wrong if this was accompanied by longer times for paying the entity's own liabilities. Otherwise, a risk of deteriorated financial liquidity may occur leading to a domino effect and financial loop<sup>20</sup>. The situation was confirmed by the growth of the demand for debt recovery services.

## 5 Price discounts in the control of receivables

Keeping financial liquidity on the required level includes actions related to the approval of trade credits, credit risk assessment, proper security and management of receivables. The last stage in the circulation of money in an enterprise is the conversion of receivables into cash<sup>21</sup>.

From the point of view of financial liquidity, receivables are frozen assets and the aim of the management of receivables should be minimisation of their level and increasing the probability of their collection<sup>22</sup>. Companies develop different systems of influencing the level of receivables. One of them is the policy of price discounts in order to accelerate the payment of receivables, thus reducing the cycle conversion into cash (Graph 6).

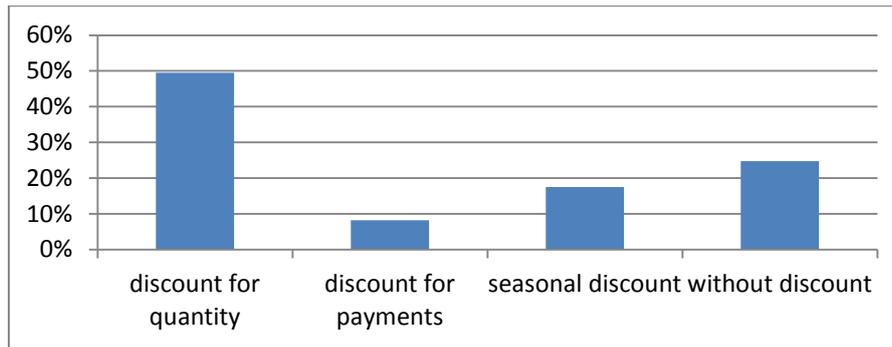
<sup>20</sup> Tokarski M. - *Factoring w małych i średnich przedsiębiorstwach*. Oficyna Ekonomiczna, Kraków 2005, p. 106.

<sup>21</sup> Sierpińska M., Tomala P. - *Metody przyspieszenia spływu należności do przedsiębiorstwa* [in] *Metody zarządzania finansami we współczesnych przedsiębiorstwach* (red. P. Szczepankowski). WSFiZ, Warszawa 2004, p. 291.

<sup>22</sup> Goławska-Witkowska G., Rzczycka A. - *Zarządzanie należnościami w gospodarce rynkowej* [in] *Współczesne finanse. Stan i perspektywy rozwoju finansów przedsiębiorstw i ubezpieczeń* (red. B. Kołosowska), UMK, Toruń 2008, p. 109.

<sup>18</sup> Tomaszewski K. - *Zatory szkodzą firmom* [in] *Prawo i Gospodarka*, 9.08.2001.

<sup>19</sup> Ibidem



Graph 6. Types of price discounts provided by entities from the Płock subregion  
(source: based on own studies)

Polish dictionary defines the term ‘discount’ as a reduced price of a good or service granted by the seller to the buyer mainly when large purchases are made<sup>23</sup>. Following the above, this would relate only to a reduced price for a purchase of sufficiently large amount of goods or sufficiently high frequency of the purchases. A discount is tantamount to a discount, a price reduction. Yet, in other definitions, these terms are slightly distinguished. The term of price reduction has been confined to a reduced price resulting from a compensation for losses<sup>24</sup>. A discount has a wider meaning and denotes prices lower than the agreed ones for those who pay in cash, purchase in large amounts at a given frequency<sup>25</sup>.

A discount for large purchases denotes a reduced price for a given good or service granted to the buyer if a given purchase quota is realised. Hence, according to the definition of the Polish dictionary we can refer to it as a discount or a discount. A non-cumulative quota discount results from an initial price reduction because of a one-off purchase of a sufficient amount of goods. A cumulative quota discount denotes a price reduction of the initial price resulting from a sufficiently frequent purchases of given goods or services in a defined period.

In practise, the most frequently applied discounts are those related to the quantity or frequency of the purchases. They allow to tie the supplier to the client, reduce the risk of demand fluctuation in the case of cumulative discount and when non-cumulative discount is applied the price discount will result from the

reduction of the costs of keeping the goods in stock, transport or packaging.

A seasonal discount applies in businesses characterised by their seasonality. The seller reduces the prices for the clients who will buy the goods or services in a low season. This reduces the costs of storage and secures the flow of cash in dead-seasons.

Functional discount reduces the prices for the middlemen for fulfilling certain functions and this extent depends on the extent of the costs that they assume.

From the point of view of the management of receivables the most significant seems the discount for ‘payment’ given to those recipients who are willing to pay before the invoice due date specified in the contract. Such a description in the Polish dictionary corresponds to the term prompt payment discount defined as *a price reduction for goods sold in installments or through a bank loan to a client paying in cash ahead of schedule*. If the date of realisation of the cash discount is delayed by several days from the moment of the concluding of the transaction, we refer to it as discount for cash<sup>26</sup>. In the crisis, purchasing discounts in kind are getting increasingly prominent, consisting in maintaining the price level and offering an additional product without charge<sup>27</sup>. Their superiority is the possibility of maintaining the nominal prices for the client and a higher profit margin. These discounts have recently gained popularity in the homebuilding industry that feels the consequences of the crisis most.

<sup>23</sup> Szymczak M. - *Słownik języka polskiego*, t. 2, PWN, Warszawa 1988, p. 536.

<sup>24</sup> Szymczak M. *Słownik...*, op.cit., t. 1, p. 188.

<sup>25</sup> Szymczak M. - *Słownik...*, op.cit., t. 3, p. 5.

<sup>26</sup> Bień W. - *Zarządzanie finansami przedsiębiorstwa*. Difin, Warszawa 2002, p. 174.

<sup>27</sup> Gorzeń W., Simon H, Zinoecker R. - *15 taktyk prowadzących do szybkich wygranych* [in] *Harvard Business Review*, Numer Specjalny - *Zarządzanie w niepewnych czasach: skuteczne narzędzia i strategię*, 2009, www.hbrp.pl (accessed on 12.06.2009).

In the surveyed group of enterprises, the most popular were the discounts for large purchases, granted by half of the respondents. Tools that may have contributed to a faster collection of the money were of little popularity. Only 8% of the entities gave their contractors discounts for prompt payments. Most of the transactions were realised without security. It seems that in the situation when problems appear with timely payments, business entities should be interested in taking every action to encourage the contractors to pay as promptly as possible. We cannot be more wrong. Despite the fact that many entrepreneurs complained about the payment discipline of their contractors, they did not take any actions motivating the debtors to pay in time<sup>28</sup>.

Trade credit for most of the recipients is a flexible source of financing and its use usually does not incur any costs. However, if we want to get a cash discount, a profitability analysis is necessary. Trade credit is, in principle, a loan granted to the client and the extent of the cash discount corresponds to the interest rate. That is why every discount must be carefully analysed and calculated.

Giving any of the discounts must be economically justified i.e. measurable evidence of the advantage of benefits over the costs must be observed. In relation to discounts arising from the quantity or frequency of purchased products it is of vital importance to ascertain the optimum quantity of goods at which the total costs of sales is minimum and constitutes a basis for further price reduction. As far as discounts for prompt payment are concerned, the basis is the costs of the granted loan, counted as cash discount<sup>29</sup>.

## 6 Selected tools for management of receivables

Any credit, irrespective of its form, brings a risk of non-payment by an insolvent debtor. An obvious element accompanying the credit should be the application of tools that improve security against such risk.

There are many instruments for the management of receivables and their variety makes it easy for each entity to find a suitable one. The only requirement is the commitment to searching for an appropriate solution. Yet, despite a wide offer of solutions the range and method of their use by the companies is insuffi-

cient. For the majority of the entities this is still too complex and professional support is necessary from financial institutions offering specific solutions. Business entities, irrespective of the industry, choose the simplest solutions, which unfortunately translates into lower effectiveness. This problem is common in small and medium businesses that do not have sufficient knowledge and expertise in this matter.

Amicable debt recovery has become difficult these days. Very often, the lack of payment is not caused by the intention not to pay or even bad financial situation. The reason may as well be delayed payments by debtors of the party in default.

One of the ways to reduce the receivables and accelerate the flow of cash is the recipient's credit. In practise, it is advance payments and prepayments<sup>30</sup>. This means that the supplier receives the payment prior to manufacturing and delivering the goods. It can be granted free of charge or an additional cost of alternative financing may be included.

The results of the conducted survey have confirmed that despite a wide range of possibilities of using different tools for the management of receivables, the respondents do not use them efficiently.

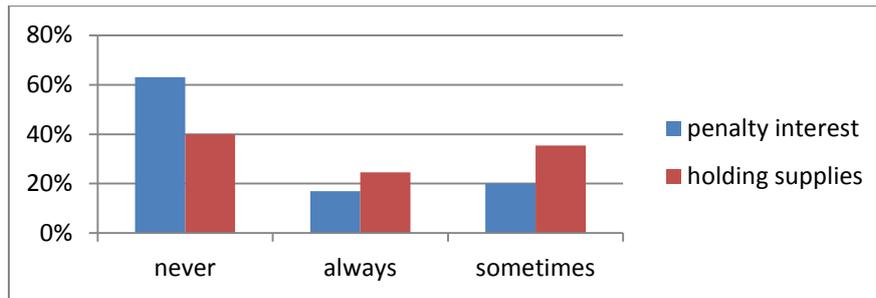
The survey has shown that most of them applies only the most popular, simplest and cheapest solutions, but, consequently the least efficient.

The recipient's credit has been indicated by more than half of the respondents as a tool used at least 'frequently' (Graph 7). The tool of increasing popularity in Poland referred to as 'factoring' came rather low in the responses – 70% declared not to have ever used this tool. On the other hand, however, the policy of applying penalties to clients for late payments was not frequently applied. Over 60% of the respondents never charged penalty interest for overdue payments and only every fifth respondent decided to use this tool 'sometimes'. Similar was the situation regarding holding of the supplies to a recipient in default. 40% of the entities did not use this tool and only every fourth respondent deemed this as normal. Trouble in one business entity is a reason for further disturbances complicating the situation in the supply chain just like in the domino effect. Yet, despite delays in payments and the increasing level of overdue payments in the activity of the surveyed business entities there were no incentives for timely payments (discounts for prompt

<sup>28</sup> Rostek K., Wiśniewski M., Kucharska A. - *Cloud business intelligence for SMEs consortium* [in] *Foundations of Management*, Vol. 04, No. 01(7), 2012.

<sup>29</sup> W. Bień - *Zarządzanie ...*, op.cit., p. 174.

<sup>30</sup> Sierpińska M., Wędzki D. - *Zarządzanie ...*, op. cit., p.192.



Graph 7 Penalty interest and holding supplies in the enterprises of the Płock subregion  
(source: based on own studies)

payment, penalty interest for overdue payments). Based on the above-presented surveys we may infer that the awareness of the managers of the enterprises as to the possibilities of use of tools for management of receivables was insufficient.

The surveys have confirmed a thesis that despite many possibilities created by the market in terms of management of receivables entrepreneurs do not use all legal means to penalise the partners in default. A business entity that is in default with payments should expect consequences such as creditor's surcharge for the use of his capital (interest).<sup>31</sup> Such an approach should be of vital importance in the times of ever growing payment backlogs. This is, however, only theory. Incurring interest is a right not an obligation of the creditor and in practise few enterprises take this opportunity. On the other hand motivating partners to pay in time by applying cash discounts for prompt payments is not a frequent practise either<sup>32</sup>.

Good solutions for companies that have problems with timely payments are barter transactions. A barter contract allows exchanging goods for goods and services for services, goods for services and vice versa. It assumes a mutual compensation of the liabilities but it is exclusively based on non-monetary exchange. In a case when part of the contract is settled through monetary medium and part through a barter transaction we have a compensation contract<sup>33</sup>.

Management of receivables is a process tightly related to the idea of securing the continuation of the company activity and maintaining its financial liquidity. This pertains to all entities irrespective of their size or specific industry. This process should entail clear rules and conditions of sale (coherent with the business entity main objective) that will constitute an important component of the policy of trade credit approval.

Management of receivables is not only the control of the timely payments, debt recovery in case of overdue payments, disciplining the debtors but also very often underestimated proactive behaviour. Its aim should be determining of the risk level related to a given transaction already on the stage preceding the signing of a contract and then, depending on the results of the assessment, differentiating the trade conditions. In order to minimise loss, an important activity in the process of management of receivables should be the adaptation of preventive actions to the previously assessed risk level.

## 7 Conclusions

Maintaining financial liquidity is a necessary condition for the continuation of economic operations. In the time of crisis when predicting future economic situation and future solvency is difficult, the care for financial liquidity becomes extremely important.

It is noteworthy that an important factor in the attempt to increase the interest in individual tools for management of receivables is educating the entrepreneurs and boosting their awareness of the existence of financial instruments, which directly translates into the ability to use them. Actions aiming at dissemination and spanning of knowledge of the entrepreneurs and company management on the available tools for security of transactions with deferred payments are one of the most desirable changes to improve the activity in this

<sup>31</sup> Hajkiewicz-Górecka M. - *Conceptions for Financing a Universal, Open, Repository Hosting and Communication Platform for Web-Based Knowledge Resources* [in] Foundations of Management, Vol. 04, No. 02(8), 2012.

<sup>32</sup> Ludynia A. - *Smart grids in the process of building a competitive economy and energy security in Europe* [in] Foundations of Management, Vol. 04, No. 02(8), 2012.

<sup>33</sup> Krupa T., Ostrowska T. *Decision-Making In Flat And Hierarchical Decision Problems* [in] Foundations of Management – Vol. 04, No. 02(8), 2012.

area. In this respect, a vital role is played by financial institutions. The planned changes should first include adapting their offer to the specificity, needs and expectations of the entrepreneurs seeking effective solutions in the management of receivables.

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## THE MUTUAL BENCHMARKING METHOD FOR SMES' COMPETITIVE STRATEGY DEVELOPMENT

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**Abstract:** Competitive advantage is a relative feature, evaluated in respect of other competing enterprises. The gaining of sustainable competitive advantage is conditioned by knowledge of own performance and the results of the competitive environment. SMEs have limited opportunities to obtain such information on their own. The method of mutual benchmarking changes this situation by introducing the collaborative network. The aim of the cooperation is to support each of the group members to achieve sustainable competitive advantage, which is the result of a conscious strategy, and not only a matter of chance. This cooperation is based on the collecting and processing of data and sharing information through a common IT platform: for example, a group of Polish SMEs was shown how to implement such a common IT solution and how to provide the information preparing within the proposed service. The whole is a complete proposal for effective support of creating a competitive strategy in SMEs.

**Keywords:** competitiveness, competitive position, competitive analysis, competitive strategy, mutual benchmarking, SME sector.

### 1 Introduction

In today's economy, a variety of entities (countries, regions, cities, sectors, industries, clusters, enterprises, groups of people, individuals) compete in the local and international markets for access to objects of rivalry (such as customers, resources, products, services, capital, knowledge, work, power, position, prestige and many others) [Pettigrew, 1988; Porter, 1990–2011]. Due to the large span of the competitiveness concept, being precise about its definition is extremely difficult and it is still an object of research [Balkyte & Tvaronavičiene, 2010; Cellino & Soci, 2012].

In this paper, the definition of competition as the company's ability to design, produce and sell products and services for which demand is greater than corresponding products and services offered by their competitors has been accepted [Porter, 1998; Ajitabh & Momaya, 2004]. Such an understanding of competition is considered to be the most important mechanism from the economic point of view, by which promoting the most favourable solutions triggers the creativity of rival market entities, which in turn leads to the development of the economy and improvement of the living conditions of the whole population [Begg, 1999; Garengo, et al., 2005; Porter, 2011; Magretta, 2011].

This creativity, understood as business innovation, has a decisive impact on the competitive advantage in the market [Porter, 1990–2011; Gunday, et al., 2011].

The measure of this advantage is the competitive position, defined always in relation to the positions held by the competitors [Porter, 1980–1985; Moon & Newman, 1995]. According to the researchers [Feurer & Chaharbaghi, 1994; D'Aveni, 2010], improving the competitiveness of a company means a move for a better, a more favourable competitive position. Realisation of this goal requires determining in which of the business functions (such as sales, marketing, production, logistics, personnel management, research and development) the company is able to achieve a competitive advantage and what value of the competitive position it would like to get in a defined time. This in turn requires knowing the results of the functioning of the company and its competitors in terms of:

- the results of business operations, which allows its activity to be compared with the activities of other players in the market and learning through the use of best practises,
- the values of competitiveness determinants, which enables the strengths and weaknesses of the enterprise and the potential areas of competitive advantage to be identified,
- assessing the own competitive position in relation to the position occupied by the competitors in the current state of the market.

Acquiring this information requires access to the data documented by the results of business activities of other competitors on the market, and then collecting

and processing them into the form of an accessible, understandable and useful analytical report. For this purpose, it is necessary to use advanced information technology from group analysis and reporting systems, like Business Intelligence (BI). As shown by conducted research [Lee, et al., 2010; Rostek, 2010; Zeng, et al., 2010], the typical SME company is not able to meet these requirements, because its competitiveness potential, conditioned and limited by available resources, is not sufficient.

The author's concept of mutual benchmarking services, following the world trends in the development of competitiveness [Brandenburger, et al., 1998; Cellino & Soci, 2012], refers to the etymology of the word *competitiveness* (Lat. *concurrere, cum petere*), which means *the common search, performing or striving for the same goal*, i.e. achieving and maintaining the company's assumed competitive position.

This understanding of the concept of competitiveness allows certain forms of cooperation in the framework of the competitive market, whose different variants are known and described in the literature under the name of collaboration network [Malecki & Tootle, 1996; Rosenfeld, 1996; Bernal, et al., 2002; Kingsley & Malecki, 2004; Zeng, et al., 2010].

In the benchmarking mutual service the cooperation network is established to strengthen the competitive potential of a group of companies to a level allowing the information necessary to achieve a sustainable competitive advantage by the participants to be obtained.

The concept of this service is presented in this paper in the following sections. Section 2 presents the research question, main target and hypothesis of the research work. Section 3 describes the research methods and tools used in the work. In Section 4, the benchmarking method is presented in the context of its use in the competitive analysis. Section 5 contains the author's concept of the method of mutual benchmarking. A case of the use of this method in Polish SME dental clinics is given in Section 6. Discussion of the results obtained and directions for further research are presented in Section 7.

## 2 Research objective

As is apparent from the research of the SME sector in Poland [Rostek, 2010; Bilińska-Reformat, 2011; Dziekoński, 2011], people managing these companies make decisions based primarily on their own knowledge and experience (approximately 90% cases, [Rostek, 2010]). Nearly 40% of respondents declare using analysis and reports in the management process, and even fewer, about 20% of the respondents use specialised tools to support decision-making [Rostek, 2010]. The only analysis and reporting IT solutions used in the surveyed companies are Microsoft Excel and StatSoft Statistica Package Base [Rostek, 2010]. This situation results from the specifics of the SME sector in Poland and is associated with a lack of appropriate potential in the following:

- knowledge and experience of the implementation of competitive analysis and using its results to create a competitive strategy,
- financial, technical, human and organisational resources necessary for the implementation of IT solutions supporting the advanced competitive analysis,
- qualified staff responsible for the handling, maintenance and development of IT solutions, ensuring the implementation of competitive analysis, development and distribution of results reports,
- the number of generated and collected data resources, which are the power source for competitive analysis.

This results in insufficient use of the available information and knowledge in the management of competitiveness. Meanwhile, SMEs need to deal not only with the competitive advantage of large companies, but also with the competition from each other, so the truth becomes the statement of Comarch representatives, that: "*small business needs the same as large, but faster, better and cheaper*"<sup>1</sup>. On this basis it is possible to formulate a research question:

**RQ:** *What methods and resources can provide SMEs with access to the knowledge that will ensure that a sustainable competitive advantage can be obtained?*

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<sup>1</sup> Series of Comarch conferences organized for the SMEs in nine Polish cities on 6-16 November 2007.

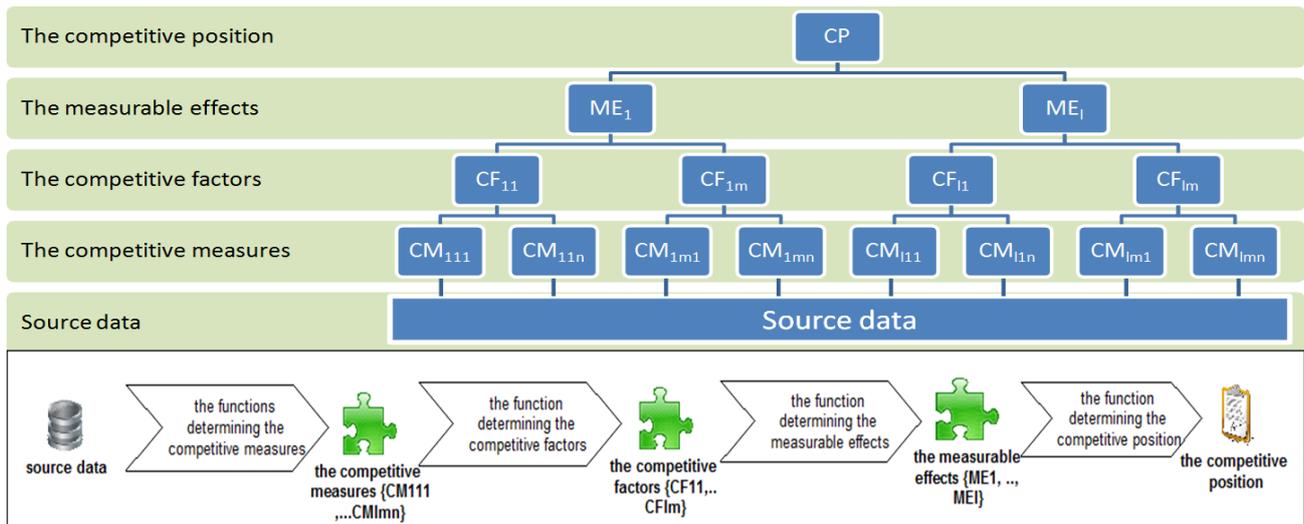


Figure 1. HCAM – Hierarchical Competitiveness Assessment Model

(source: own research)

Therefore the research objective is:

*RO: To develop a comprehensive tool supporting SMEs in:*

- identifying the criteria that are determinants of the company competitiveness;
- developing a strategy that will guarantee the achievement of the assumed competitive position;
- supporting the implementation of all the above items using modern and the most relevant methods and technologies.

After considering the above, the following research hypothesis was formulated:

*RH: The method of mutual benchmarking, assuming shared access to the results of the competitive analysis within the group, is the competitive alternative to conventional tools and methods in creating a competitive strategy and providing a sustainable competitive advantage in SMEs.*

### 3 Research methodology

In order to carry out the proof of the formulated hypothesis and find answers to the defined research question, a two-step research plan was developed, which contained:

- a quantitative research,
- a research experiment.

Quantitative research<sup>2</sup> (in the form of a direct interview, using the electronic form called *CAPI – Computer-Assisted Personal Interviewing*) was conducted in a group of Polish dental clinics. The survey sample was selected with a purposely random method among all private dental practises in the SME sector, of which, in 2009, there were 3693 [Walkowska, 2010–2011]. The purposefulness of selection was based on the fact that all the clinics were located in large Polish cities, had computers and belonged to the SME sector. The required sample size for this set was determined by the following assumptions:

- confidence level  $(1 - \alpha) = 95\%$ ,
- confidence interval  $t = 1.96$ ,
- estimation of the population fraction possessing the analysed characteristic  $p = 50\%$ ,
- estimation of the population fraction not possessing the analysed characteristic  $(1 - p) = 50\%$ ,
- the maximum permissible error of measurement  $d = 8\%$ .

After considering all this, the minimum sample size was set at 150 clinics:

$$n = \frac{t^2 p(1-p)}{d^2} = \frac{1,96^2 * 0,5 * 0,5}{0,08^2} = 150,0625$$

The hierarchical competitiveness assessment model (HCAM) was adopted for evaluating the competitiveness in a defined research sample (**Błąd! Nie można odnaleźć źródła odwołania.**, [Rostek, 2012]).

<sup>2</sup> Scientific work financed by the budget funds for sciences in 2009-2011 as a research project.

Table 1. The structure of the competitive factors in the division of the areas of measurable effects  
(source: own research)

Measurable effects		Competitive factors	
ME <sub>1</sub>	modernity and quality of provided medical services	CF <sub>11</sub>	technological level
		CF <sub>12</sub>	quality of service
ME <sub>2</sub>	ability to satisfy the needs of patients	CF <sub>21</sub>	timely realisation of services
		CF <sub>22</sub>	lasting relationships with customers
ME <sub>3</sub>	achieved sales results	CF <sub>31</sub>	sale
		CF <sub>32</sub>	costs and expenses
		CF <sub>33</sub>	usage of fixed assets
		CF <sub>34</sub>	employee productivity

Table 2. The structure of the competitive factors broken down by the competitive measures  
(source: own research)

Competitive factors	Competitive measures	
CF <sub>11</sub>	CM <sub>111</sub>	the sales of innovative medical services as a % of the total sales value
	CM <sub>112</sub>	the costs of investment and development as a % of the total sales value
CF <sub>12</sub>	CM <sub>121</sub>	the number of complaints as a % of the total number of sold services
	CM <sub>122</sub>	the value of the complaints as a % of the total sales value
	CM <sub>123</sub>	the number of registered patients per one employed medical person
CF <sub>21</sub>	CM <sub>211</sub>	the average duration of a visit
	CM <sub>212</sub>	the average waiting time for a visit
CF <sub>22</sub>	CM <sub>221</sub>	the number of patients using the services of the clinic repeatedly as a % of the total number of patients
	CM <sub>222</sub>	the number of patients using the services of the clinic permanently as a % of the total number of patients
	CM <sub>223</sub>	the number of patients from long distance using the services of the clinic as a % of the total number of patients
	CM <sub>224</sub>	the number of foreign patients using the services of the clinic as a % of the total number of patients
CF <sub>31</sub>	CM <sub>311</sub>	the number of sold services per one employed medical person
	CM <sub>312</sub>	the value of sales of medical services per one employed medical person
	CM <sub>313</sub>	the return on sales
CF <sub>32</sub>	CM <sub>321</sub>	the average salary of medical staff
	CM <sub>322</sub>	the average salary of administrative staff
	CM <sub>323</sub>	the labour costs of administrative staff as a % of the labour costs of medical staff
	CM <sub>324</sub>	the labour costs of medical personnel as a % of the total value of sales services
	CM <sub>325</sub>	the costs of promotion and marketing as a % of the total value of sales services
CF <sub>33</sub>	CM <sub>331</sub>	the total value of fixed assets as a % of the total value of sales services
	CM <sub>332</sub>	the value of medical equipment as a % of the total value of sales services
CF <sub>34</sub>	CM <sub>341</sub>	the value of medical equipment per one employed medical person
	CM <sub>342</sub>	the value of profit per one labour hour of medical staff
	CM <sub>343</sub>	the number of employees subject to any form of training

Table 3. The structure of the data source  
(source: own research)

Source data	Description of source data
<i>Data about patients:</i>	
LPO	Total number of patients
LSP	Number of patients who used the services of the company at least 3 times a year
L3L	Number of patients who have been patients for at least 3 years
LPZM	Number of patients living more than 50 km from Warsaw
LPZG	Number of foreign patients
<i>Data about sales of services:</i>	
SB	Value of gross sales of services in PLN thousands
SN	Value of net sales of services in PLN thousands
SUN	Gross value of sales of innovative services in PLN thousands
ZS	Profit
LWO	Number of visits in the period
SCO	Average patient's wait time for a visit in days
SCT	Average duration of a visit in minutes
LR	Number of complaints reported by patients
WR	Gross value of complaints reported by patients in PLN thousands
<i>Data about employees:</i>	
PO	Total number of employees
PM	Number of medical employees
PA	Number of administrative personnel
PS	Number of workers benefiting from any form of training
LRM	Number of man-hours worked by medical personnel
LRA	Number of man-hours worked by administrative personnel
SPM	Average wage rate of medical personnel
SPA	Average wage rate of administrative personnel
KRM	Labour cost of medical personnel in PLN thousand
KRA	Labour cost of administrative personnel in PLN thousands
<i>Data about costs incurred:</i>	
KM	Cost of medical supplies in PLN thousands
KN	Costs of inspections and repairs of medical equipment in PLN thousands
WS	Value of medical equipment in PLN thousands
WZM	Value of stocks of medical supplies in PLN thousands
KMR	Marketing and promotion costs in PLN thousands
WIR	Investment and development expenditure in PLN thousands
CWST	Total value of fixed assets in PLN thousands
WB	Value of buildings in PLN thousands

The HCAM model contains the following elements:

- the source data – data generated and provided by the companies, which are the results of their activities,
- the competitive measures – source data transformed into a comparable form between the different members of the group; for example, on the basis of the source data of the “total number of clients”, the measure of “the number of clients per 1 employee” was defined,
- the competitive factors – the aggregated and normalised value (on the scale of 0–100 points) of these competitive measures, which belong to the competitive factor,
- the areas of measurable effects – the aggregated value of these competitive factors, which belong to the area of the measurable effects,
- the competitive position – the aggregated value of all areas of the measurable effects.

Its primary purpose was to determine the values of the competitive position of each clinic, based on its activities performance within defined periods of time. The standard method of measuring the competitive position takes into account the value of the identified competitive factors (i.e. *criteria that designate areas of competition*) and their weights:

$$fCP: CP = \sum_{i=1}^1 CF_i * w_i \quad (1)$$

where:

- CP = value of the competitive position,
- CF<sub>*i*</sub> = value of the *i*-th competitive factor,
- w<sub>*i*</sub> = weight of the *i*-th competitive factor.

Formula (1) indicates that the basis of determining the competitive position is to identify the factors influencing the competitiveness. These are the criteria designated by the key competitive areas, such as: price and quality of the products/services, volume and profitability of sales and staff productivity. To identify the competitive factors of Polish dentist clinics, the results of the quantitative research and the secondary research were obtained (i.e. reports: PKPP Lewiatan<sup>3</sup> [Starczewska-Krzysztozek, 2005-2008] and PARP<sup>4</sup> [Żołnierski, 2007–2009; Wilmańska, 2010]). On this basis, eight key factors of competitiveness have been

highlighted, belonging to three groups of measurable effects (**Błąd! Nie można odnaleźć źródła odwołania.**).

The value of the competitive factors was counted as the aggregate of the competitive measures connected with these factors (**Błąd! Nie można odnaleźć źródła odwołania.**).

The competitive measures were calculated based on the source data (**Błąd! Nie można odnaleźć źródła odwołania.**), provided by the users of the HCAM model.

As shown in **Błąd! Nie można odnaleźć źródła odwołania.**, the developed model expands the standard method for determining the competitive position to the sublevels of the competitive measures and the areas of the measurable effects. This is justified by the fact that the competitive measures guarantee the comparability of source data belonging to the differentiated entities, and the measurable effects are shown in the competitive position in the key competitive areas of these entities. The whole is implemented in accordance with the following procedure:

- 1) At the start the values of individual competitiveness measures CM<sub>*ijk*</sub> are calculated from the formulas fCM<sub>*ijk*</sub>, associated with each of measure:

$$CM_{ijk} fCM_{ijk}: CM_{ijk} = f(DS) \quad (2)$$

where:

- DS – appropriate data source,
- CM<sub>*ijk*</sub> – *k*-th competitiveness measure of *j*-th competitiveness factor in *i*-th measurable effects area,

for example:

$$CM_{123} = LPO/PM,$$

$$CM_{342} = ZS/LRM.$$

- 2) On the basis of competitiveness measures are determined values of weighted competitiveness factors:

$$fCF_{ij}: CF_{ij} = \sum_{k=1}^n CM_{ijk} * w_{ijk} \quad (3)$$

where:

- n – number of competitiveness measures defined for particular competitiveness factor,
- CF<sub>*ij*</sub> – value of *j*-th competitiveness factor in *i*-th measurable effects area,
- CM<sub>*ijk*</sub> – *k*-th competitiveness measure of *j*-th competitiveness factor in *i*-th measurable effects area,

<sup>3</sup> PKPP Lewiatan (pol. Polska Konfederacja Pracodawców Prywatnych Lewiatan) – Polish Confederation of Private Employers “Lewiatan”.

<sup>4</sup> PARP (pol. Polska Agencja Rozwoju Przedsiębiorczości) – Polish Agency for Enterprise Development.

$w_{ijk}$  – weight assigned to competitiveness measure  $CM_{ijk}$ , and the sum of weights  $w_{ijk}$  designated for each competitiveness factor  $CF_{ij}$  is 1:

$$CF_{ij} \sum_{k=1}^n w_{ijk} = 1 \quad (4)$$

3) Then competitive measures were aggregated to the value of individual areas of measurable effects  $ME_i$ :

$$fME_i: ME_i = \sum_{j=1}^m CF_{ij} * w_{ij} \quad (5)$$

where:

$m$  – number of competitiveness factors defined for particular area of measurable effects,

$ME_i$  – value of  $i$ -th measurable effects area,

$CF_{ij}$  –  $j$ -th competitiveness factor in  $i$ -th measurable effects area,

$w_{ij}$  – weight assigned to competitiveness factor  $CF_{ij}$ , and the sum of weights  $w_{ij}$  designated for each measurable effects area  $ME_i$  is 1:

$$ME_i \sum_{j=1}^m w_{ij} = 1 \quad (6)$$

4) Finally on the basis of individual assessments of measurable effects areas has been designated aggregated evaluation as competitive position CP, occupied by each dental clinic in research group:

$$fCP: CP = \sum_{i=1}^l ME_i * w_i \quad (7)$$

where:

$l$  – number of areas of measurable effects,

$ME_i$  – value of  $i$ -th measurable effects area,

$w_i$  – weight assigned to  $i$ -th measurable effects area  $ME_i$ , and the sum of weights  $w_i$  for competitive position CP is 1:

$$\sum_{i=1}^l w_i = 1 \quad (8)$$

The HCAM model has become an initiating element of the research experiment, conducted on a selected group of 10 clinics from 150 covered by the quantitative survey. The aim of the experiment was to evaluate the usefulness of the mutual benchmarking services in the development competitiveness strategies in comparison with the methods and tools currently used in these entities.

The research experiment was carried out in the period from 11-2009 to 06-2010. At that time, clinics were providing the source data for the HCAM model and in return were receiving results of the competitive analysis, like this:

- changes in the results of the HCAM model during the time of each clinic,

- the assessment of the current competitive position in the clinic's group,
- the assessment of the impact of the competitive factors on the competitive position value in the clinic's group,
- the list of activities guaranteeing the assumed value of the competitive position in the clinic's group.

In the case of the results analysis of the HCAM model and determination of the current competitive position of the, each clinic has benefited from statistical data analysis and graphical visualisation of its results. To determine the importance and selection of the competitive factors for the clinic's group the regression method was used. In order to develop a useful sequence of activities ensuring the achievement of the assumed competitive position in the clinic's group, a method of decision trees was used. The whole analysis was implemented and handled by a dedicated BI solution. The results of the obtained research are discussed later in this work.

#### 4 Benchmarking as the competitive analysis method

The competitiveness of companies is a property that should determine the process of the formulating development strategy [Hitt, et al., 2012]. The measure of competitiveness is a competitive position, calculated as a result of competition from one entity in a group of competitors operating in the same market [Porter, 1998; Giachetti & Dagnino, 2013]. Therefore the main objective of the strategy of competitiveness development is to provide a plan of action that, with high probability, with well-known constraints and in assumed time, will achieve the expected competitive position.

The effectiveness of the prepared competitiveness strategy depends on knowledge of the competitive factors and the ability to predict the actions taken by the competitors [Trkman, 2010; Zeng, et al., 2010]. The source of the necessary knowledge in this area is undoubtedly the experience and skills of managers, which should be supported by information obtained as a result of the pursued competitive analysis. As confirmed by conducted research [Trkman, et al., 2010, Crough, 2011], those economic entities that take into account the results of the competitive analysis and the existing (market and non-market) constraints have the biggest chance of successful entry and effective activities on the market.

The above findings show that the achieved competitive position, as a result of the implemented competitive strategy, is constrained not only by business capabilities, but also by the parallel activities carried out by market competitors. Thus, the wider the information regarding the operation of the business and its environment, the greater the effectiveness of the prepared strategy for competitiveness. The competitive analysis usually refers to its own results, but expanded to benchmarking, i.e. the process of comparison analysis in many areas of business with other competitors will increase the management efficiency of the competitiveness development strategy [Dessler, 2004; Huggins, 2010].

The adoption of benchmarking as a method for competitive analysis [Kovačič, 2005; Raharjo, 2010] has resulted in the widening of the scope of its use. The most popular form of benchmarking is an analytical service performed in a defined area of management by the consulting and services companies (for example IBM,<sup>5</sup> Cartesian<sup>6</sup>), which have the data from a specific management area. The strengths of such a service are the high competences of service staff and access to a wide range of necessary data. The drawback, however, is its one-off nature, which is sufficient in the case of projects and undertakings, but becomes a constraint in the case of repetitive actions, such as the continuous projection and implementation of strategies.

In Poland, and across the world, there have been attempts to build and disseminate multi-user solutions in the field of benchmarking analysis [IBIS, 2006; Cooper, et al., 2010]. The strength of these solutions is their durability, openness and accessibility. The drawback, however, is that there are problems with the maintenance, development and flexibility of solutions, upgrades to processing data, and also the interpretation and utility of available results. Hence the new research trend – the knowledge-based benchmarking systems [Lai, et al., 2011] – which in a clear, accessible and useful way supports decision-making and the creation of business strategy. The ability to use these solutions entails the need to implement advanced IT technologies such as BI [Completo, et al., 2012].

Benchmarking, used as a method of competitive analysis, increases the possibility of traditional analysis,

because it not only measures the effects of the strategy, but also identifies causes and points to the possibility of their improvement. Therefore modern benchmarking methods such as the European Benchmarking Procedure [European Commission, 2010; Maggetti & Gilardi, 2011] or clusters benchmarking [Ketels, 2012; Park, et al., 2012] show how effectively benchmarking can be used to support a competitive strategy.

In the European Union, benchmarking has become a key instrument in the Open Method of Coordination, supporting the achievement of the competitive advantage in member states in terms of both economic and social objectives [Arrowsmith, et al., 2004; Bruno, 2009; European Commission, 2010]. The method is based on mutual learning through the identification and transfer of best practises at different levels of economy management (i.e. sectoral, national and transnational). On this basis, new benchmarking methodologies are created, taking into account the scope, principles and conditions for their implementation [Dévai, et al., 2002; LILAMA, 2010].

Also, the benchmarking of clusters, led by the ESCA (*European Secretariat for Cluster Analysis*), is found widely used in the European Union. The ESCA has registered 190 clusters and is currently providing the results of a comparative study in the area of organisational structures, processes, products and services [ESCA, 2012]. They also make comparisons on a smaller scale, for example for clusters operating in a specific industry [ABC-Network, 2007; INOVISA, 2012].

The advantage of the presented methods is a wide range of available comparisons and supporting the process of the European institutions. The limitations are the need to involve significant resources and incurring high investment outlays, which require the involvement of government institutions (the European Benchmarking Procedure) or a larger group of cooperating and competing entities (the benchmarking of clusters). In this context, one can see the need for such an implementation of a benchmarking method, which will be more accessible and flexible for SMEs, which function primarily in the local market, have only a little knowledge and experience in the field of European cooperation and remain outside the existing clusters. The proposed solution is the mutual benchmarking method.

<sup>5</sup> <http://www-03.ibm.com/systems/services/benchmarkcenter/>, date of reading 23-07-2013.

<sup>6</sup> <http://www.cartesian.com/technology/technical-services-and-consulting/it-benchmarking>, date of reading 23-07-2013.

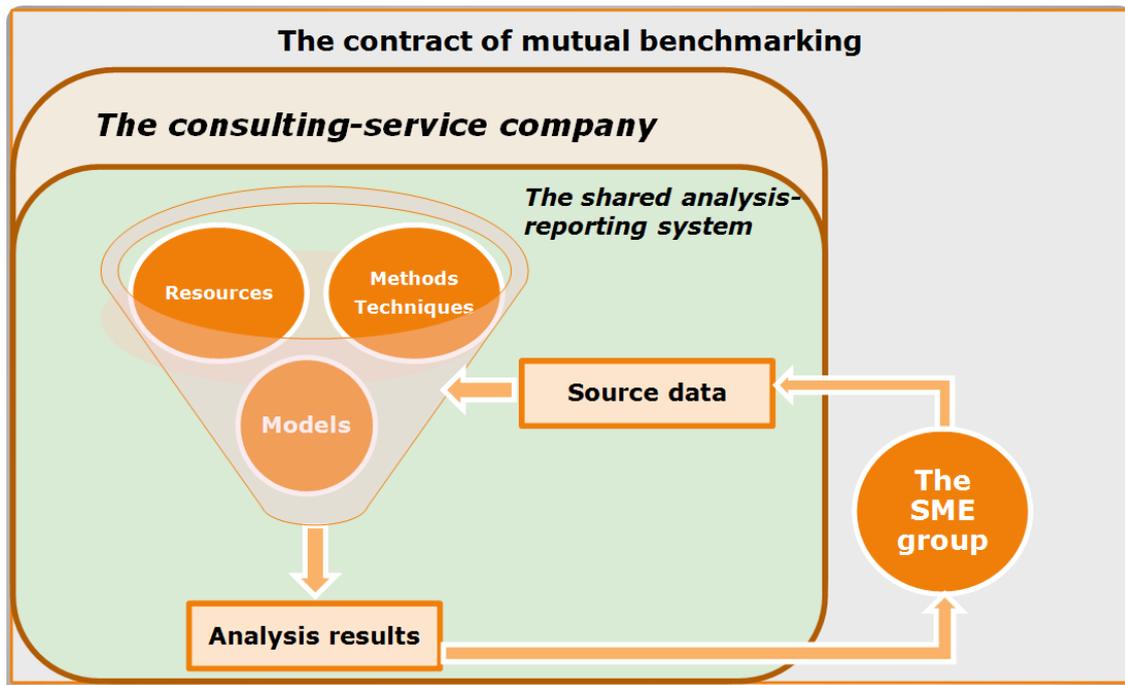


Figure 2. Mutual benchmarking method  
(source: own research)

## 5 Mutual benchmarking method for SMEs

Preparing of a competitiveness strategy in a typical Polish SME company is to collect the available results of its performance, preparing them in the form of simple statistical summaries and charts, and on this basis make strategic decisions. This mode of decision-making takes into account only the prospect of their own business, with a very general knowledge of the market and the actions taken by competitors. While a company's competitiveness is conditioned by this – which products/services and their attributes (like: quality, modernity, diversity, price, availability, delivery time, warranty, specials, discounts) offer in comparison with competitors existing in the common market. This means that the adoption of an appropriate strategy, which guarantees the achievement of competitive advantage, involves the selection of a portfolio of these criteria, within which the company wants to compete.

The development of an appropriate strategy requires access to information on the needs and expectations of the customer market and the possibility of competitors (manufacturer market), as well as the support due to the timing of the decisions and the size of the processed data. Reaching the information coming from the environment and effective (competitive) supporting tools is usually beyond the reach of a single SME com-

pany. Therefore, a collaboration remains, resulting in synergies, enabling a more complete and efficient (than would be possible individually) access to information, more accurate choice of strategy and making management decisions.

This collaboration has been included in the definition of mutual benchmarking, understood as to implement shared competitive analysis, as a result of which every group member receives information about the possibilities of effective ways to compete in this market area, which has been designated by the data set provided by the network members.

In this context the mutual benchmarking method (Figure 2) guarantees the proper organisation of companies' collaboration and realisation of competitive analysis. It is necessary to use the most suitable analytical methods, models, tools, technology and data in order to build an analysis-reporting solution. This will ensure its correct functioning and development throughout the life cycle.

While the group of SMEs would be able to run such an IT solution through a network collaboration, it would be difficult for them to keep it running in the long term due to the lack of qualified personnel.

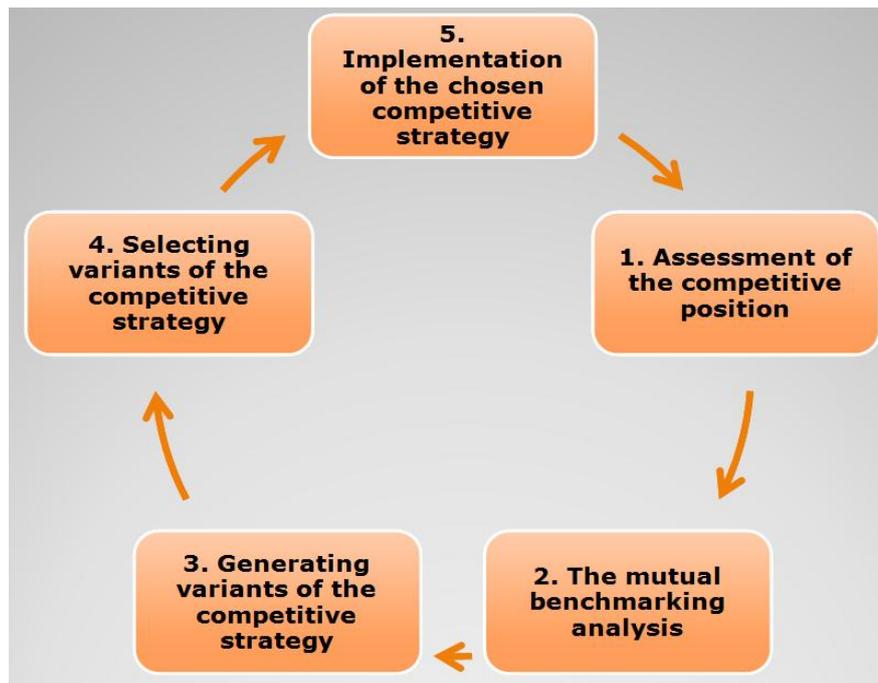


Figure 3. The life cycle of the competitive strategy in the mutual benchmarking method  
(source: own research)

For this reason, participation of an external company is necessary, which would provide continuity and functioning coordination and a full mutual benchmarking service. The proposed method (Figure 2) integrates several elements, which hitherto have been implemented independently:

- it provides knowledge of the suggested actions for the competitive strategy with a known level of effectiveness, and not exclusively statistical results of competitive analysis;
- it enables the use of advanced information technologies that are not available or cannot be used by a single SME company;
- it strengthens the analytical potential of source data by integrating the resources of multiple SME companies;
- it teaches entrepreneurs the posture of competitive cooperation in place of rivalry;
- it is a flexible form of collaboration in which the company takes the decision to join or leave the group.

The key in the implementation of the mutual benchmarking method involves a consulting-services company, responsible for the design, organisation and implementation of competitive analysis, and for providing the results in a shape and form useful to the

end-user. The consulting-services company is responsible for coordinating and monitoring the realisation of mutual benchmarking method to ensure the best its execution, expected by the participants. This expected benefit is the high efficiency of the implemented competitive strategy, as measured by the achieved competitive position. The sequence of operations making up the cycle of creating a competitive strategy in the mutual benchmarking method is presented in Figure 3.

Assessment of the competitive position requires (Figure 3, step 1): knowledge of the set of criteria having a determining impact on competitiveness, skills measuring their value and their aggregated assessment as the competitive position. Such activities are realised by using a defined HCAM model, as described in Section 3.

The mutual benchmarking analysis (Figure 3, step 2) enables the company to compare its own results, obtained from the HCAM model, with similar results obtained by the competitors. This step is particularly precious for the company because of the opportunity to learn by patterns applied and tested by competitors. Based on the results of step 1 and 2 and the current capabilities and needs of the company, possible variants of the competitive strategy are established (Figure 3, step 3).

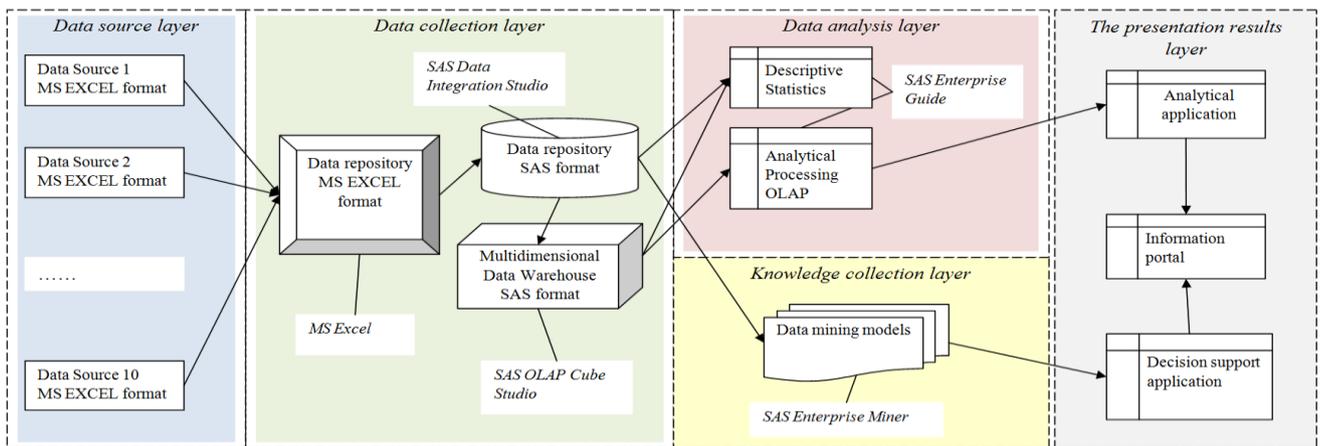


Figure 4. The dedicated Business Intelligence system  
(source: own research)

These variants, understood as a sequence of actions, the implementation of which ensures achievement of a certain competitive position, can be generated by the decision-maker on his own, but can also be supported by advanced analytical methods and technology, which is provided by the mutual benchmarking method and which is presented in the next section.

From the set of obtained solutions this variant of strategies that is optimal for the company at a given time and with known conditions and constraints must be selected (Figure 3, step 4). This step can also be performed manually by the decision-maker or automated by a specialised IT tool (as illustrated in the next section).

Step 5 (Figure 3), closing the life cycle of the competitive strategy, implements the chosen strategy variant. However, the assessment of its results will only be possible in the next iteration of the cycle, based on a new set of results of the HCAM model (Figure 3, step 1) and relating them to the results achieved at the same time by its competitors (Figure 3, step 2). An example of using the mutual benchmarking method in the group of Polish SME enterprises is presented in the next section.

## 6 The case study of using the mutual benchmarking method

Verification of the usefulness and effectiveness of the mutual benchmarking method was conducted within the research programme described in Section 3.

A characteristic feature of the selected research group was management-based intuition and their own experience resulting in highly variable financial performance (a few clinics, potential participants in the research

experiment, still announced their bankruptcy during its organisation).

Typical analyses used by these clinics to support strategic decisions are statistical reports of the achieved results and variants of simulation scenarios generated in an MS Excel spreadsheet (used especially in the case of investment decisions). The clinics had no knowledge of results obtained at the same time by their market competitors. Their effectiveness was measured by the financial results achieved, but in most cases they were not able to answer the question about which areas of their business are potential sources of competitive advantage (except for dental clinics providing custom services in unique technology). Neither could they determine which areas depart significantly from what the competition has and what it offers. So their decisions were mostly intuitive, very cautious and focused solely on survival; also the uncertainty degree and involved risk were very high. Competitive advantage achieved in this way is purely a matter of chance and it is difficult to ensure its stability over time.

Despite this situation, only a part of the group (about 35% of the 150 surveyed clinics) was aware of the fact that the low efficiency of their management was the result of a lack of information supporting decision-making. Among this group, 10 entities were selected that participated in the research experiment, using the services of mutual benchmarking to improve their competitive position and achieved results. The data supplying the HCAM model were these, that matched the requirements of the model and were also collected, processed and analysed every day in these clinics. All it was performed through a dedicated Business Intelligence System (Figure 4).

Table 4. Selection of the competitive factors – the regression analysis results  
(source: own research)

Parameter name	Freedom degrees	Parameter value	Error value	<i>t</i>	<i>p</i>
Intercept	1	0.2952	0.57440	0.51	0.6103
CF <sub>11</sub>	1	0.1658	0.00294	56.41	<.0001
CF <sub>12</sub>	1	0.1633	0.00316	51.74	<.0001
CF <sub>21</sub>	1	0.1644	0.00303	54.24	<.0001
CF <sub>22</sub>	1	0.1655	0.00226	73.16	<.0001
CF <sub>31</sub>	1	0.0932	0.00333	27.97	<.0001
CF <sub>32</sub>	1	0.0637	0.00209	30.49	<.0001
CF <sub>33</sub>	1	0.0693	0.00233	29.77	<.0001
CF <sub>34</sub>	1	0.0980	0.00240	40.83	<.0001

These data collected from all the participants in the experiment and placed in the HCAM model enabled the resulting data set to be obtained, and this was the basis for the mutual benchmarking competitive analysis.

Clinic W08 was initially the leader of the group with the highest value of the competitive position CP (56 points at 100 points max). However, the problem of this clinic was relatively low sales turnover and high costs of services, which was used by clinic W10 to become the leader of the next period (47 points at 100 max.). In response, clinic W08 (43 points at that time) decided to use the results of the analyses developed in the framework of mutual benchmarking services, formulating the following analytical question:

*Do all the competitive factors identified in the HCAM model currently have an equal impact on the value of the competitive position?*

The past experience of participants indicated that the strength of this impact is unequal and variable over time. In order to prove this hypothesis, the regression model was constructed with the CP as the dependent variable and the competitive factors as the independent variables:

$$CP = CF_{11} * w_{11} + CF_{12} * w_{12} + CF_{21} * w_{21} + CF_{22} * w_{22} + CF_{31} * w_{31} + CF_{32} * w_{32} + CF_{33} * w_{33} + CF_{34} * w_{34} + \varepsilon$$

where:

CP = the dependent variable – the value of the competitive position,

CF<sub>ij</sub> = the independent variable – the value of the *ij*th competitive factor,

w<sub>ij</sub> = the model parameter – the weight assigned to the *ij*th competitive factor,

ε = the model error – the intercept.

Choosing the IT solution in the Business Intelligence technology, developed in the framework of mutual benchmarking services, made it possible to use advanced data mining tools that aren't known and used in the SME sector. The advantage of using an advanced analytical solution was the ability to test many different variants of regression analysis and the selection of these was characterised by the lowest validation error. The following variants of regression analysis were examined:

- linear regression with a progressive method of estimation of the model parameters,
- linear regression with a backward method of estimation of the model parameters,
- linear regression with a stepwise method of estimation of the model parameters,
- regression with the iterative LARS (*Least Angle Regression*) method of estimation of the model parameter,
- regression with estimation of the model parameters using the PLS method (*Partial Least Squares*),
- two-stage method of regression.

The best results were obtained by using a two-stage regression analysis. The model proved to be significant ( $F = 3561.88$ ;  $p < 0.0001$ ). Predictors explained together 99% of the dependent variable ( $R^2 = 0.9988$ ). Detailed results of the estimation of the model parameters are presented in Table 4.

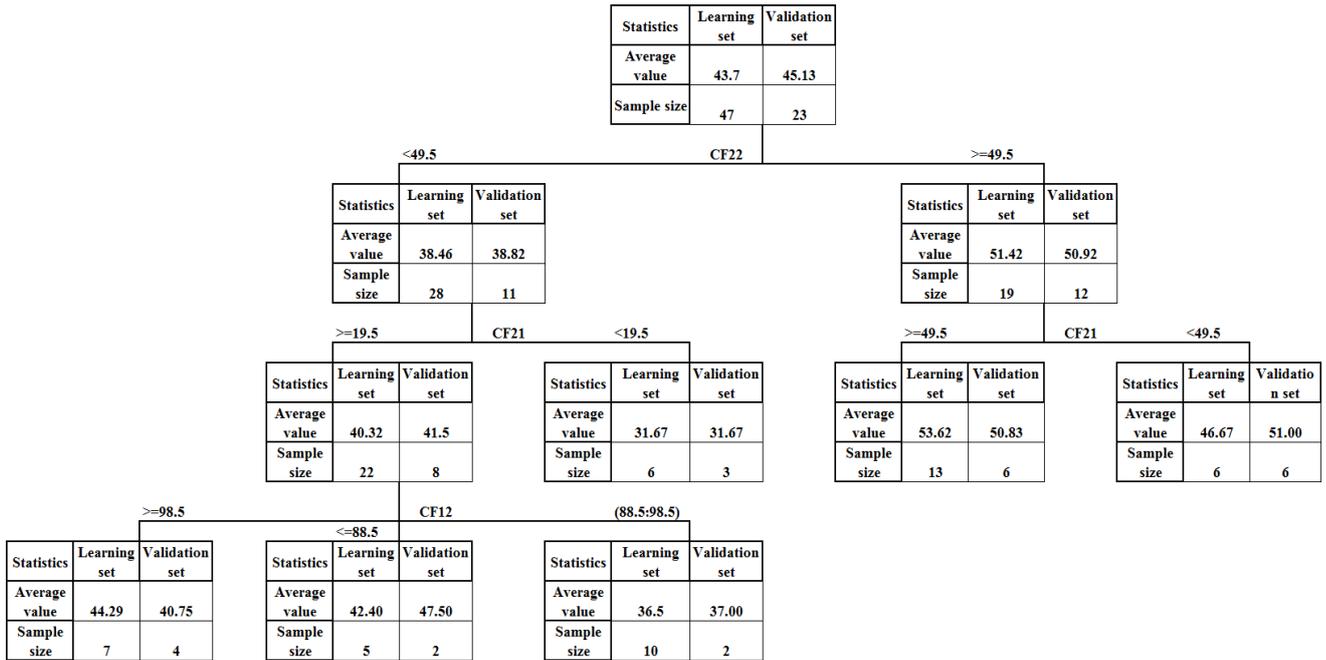


Figure 5. The suggested strategic actions – the results of decision tree analysis (source: own research)

As shown in Table 4, all the independent variables are important for the model results, which confirms the validity of their identification and selection in the HCAM model. However, during the realisation of the research experiment the greatest impact on the value of the CP had variables: CF<sub>11</sub> (technological level), CF<sub>12</sub> (quality of service), CF<sub>21</sub> (timely realisation of services), CF<sub>22</sub> (lasting relationships with customers). These are the competitive factors belonging to two areas of the measurable effects: ME<sub>1</sub> (modernity and quality of provided medical services) and ME<sub>2</sub> (ability to satisfy the needs of patients).

Knowing which competitive factors have a particular impact on the value of the competitive position, the W08 clinic formulated the next analytical question:

*In what range should the values of the identified competitive factors be changed in order to be able to achieve the assumed competitive position?*

In order to find answers to this research question, an analysis was performed using decision trees, wherein the independent variables adopted for analysis were only those competitive factors that were identified in the regression analysis as the most important because of the change in the CP value, i.e.: CF<sub>11</sub> (technological level), CF<sub>12</sub> (quality of service), CF<sub>21</sub> (timely realisation of services) and CF<sub>22</sub> (lasting relationships with cus-

tomers). The dependent variable was still the CP value. The results obtained are presented in Figure 5.

The results of decision tree analysis showed (Figure 5) that the value of the CP at the average level of 51 points (at 100 points max.) primarily impacts on the value of CF<sub>22</sub> (lasting relationships with customers), exceeding 49.5 points (at 100 points max.). If a clinic wants to achieve a higher than average CP value, it should also take care to preserve the value of factor CF<sub>21</sub> (timely realisation of services) at a level above 49.5 points (at 100 points max.).

Each clinic participating in the research experiment received the results of all these analyses. Clinics W08 and W10 also benefited from them. Apart from that W08 had treated these results comprehensively and concluded that the maintenance of high value of CF<sub>21</sub> and CF<sub>22</sub> may not be enough if other participants proceeded in the same way. Therefore it also ensured sufficiently high values for factors CF<sub>11</sub> and CF<sub>12</sub>, which clinic W10 did not do. The consequence of these proceedings W08 has returned to the position of group leader (with 58 points) and W10 has lost this position (with 42 points).

The results obtained from the research experiment showed that the use of the mutual benchmarking method is an alternative and an effective tool in the development of competition in the SME sector.

It has a substantial impact on reducing the uncertainty in the process of making strategic decisions. It also strengthens the competitive potential of recipients to a level that ensures the feasibility of the competitive analysis implementation to the same level as in the large enterprises. The final effectiveness of the method is however strongly determined by the way and extent of using the obtained information and knowledge. And this is conditioned by knowledge, experience and belief in the value and importance of competitive analysis by decision-makers.

## 7 Summary

In implementing the main aim of the research, the mutual benchmarking method was developed and presented as an alternative to traditional methods and tools of competitiveness management in the SME sector. Noticing the limitations in the availability of the resources, funds and tools required to implement competitive analysis, as part of this method an organisation for reporting and analysis a solution is proposed, dedicated to supporting the competitive development strategy for defined groups of users. The availability of this solution for enterprises with reduced financial, human and organisational capabilities is provided by delivering it in the form of a complete service.

The mutual benchmarking service supports the creation of a competitive strategy in the enterprises in terms of developing a competitive assessment model and dedicated IT solution, providing technical and organisational conditions for their implementation, delivering the solution in the form of flexible services and matching available information to the needs and capabilities of the user. The research experiment performed in the aspect of the utility of this method and the defined research hypothesis showed that although the acquired information is useful for managing the development of competitiveness, the effectiveness of its use depends on the actions taken (or omitted) by the decision-maker.

During the experiment the great meaning of the whole process of quality, quantity, detail and form of information provided to the user was observed also. This in turn determines the need for a very precise definition of the scope of the functioning of a dedicated IT solution, and above all, the form and details of the information exchanged with the user.

Benchmarking as a method to learn from the best provides the most knowledge of the competitive development strategy for those organisations that are in a lower competitive position. The organisations with a higher level of competitiveness acquire in this way the knowledge of potential risks posed by competitors, which in turn prepares them to prepare for the identified threats. This moment in which the mutual benchmarking service stops to provide new useful knowledge for its members compensates the competitive level in the whole group. When all the participants achieve a similar level of competitiveness, the group should expand the number of members by admitting new organisations or be terminated. Even then it can still take advantage and gain an advantage over its competitors, thanks to the knowledge gained through the mutual benchmarking service. In this way the mutual benchmarking method becomes a tool for knowledge transfer about effective competitive activities, which contributes to the development of method participants, but also to their immediate environment.

On this basis it should be noted that the method of benchmarking is a new form of an effective mutual support competitive strategy, which compensates the differences in access to information and knowledge for SMEs. It also has the advantage of promoting a new meaning of competitiveness, understood as competitive collaboration instead of competitive rivalry. This collaboration does not mean giving up on putting the goals of its enterprise first, but using the whole group opportunities. And in this sense it is also a new research area for supporting the development of competitiveness in the SME sector.

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# Information for Authors

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**Content of an article.** A paper may describe original work, discuss a new method or application, or present a survey of recent work in a given field. Concepts and underlying principles should be emphasized, with enough background information to orient the reader who is not a specialist in the subject. A paper submitted to the Journal should not have been published elsewhere, including the World Wide Web, nor should it be submitted to another publication or to a conference concurrently.

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- The monograph under the editing:

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[2] Ansoff H.I. (ed.) - *Corporate Strategy*. McGraw-Hill, New York 1965.

- The chapter of the monograph under the editing:

Author(s) - *Title of the chapter* [in] *Title of the monograph* (ed. Authors). Publishing company, City and the year of the publication, numbers of pages.

The example:

[3] Wilson D.C. - *Organizational Structures in the Voluntary Sector* [in] *Issues in Voluntary and Non Profit Management* (ed. J. Batsleer, C. Cornforth, R. Paton). Addison-Wesley, Wokingham 1992, pp. 45-93.

- The article in the journal:

Author(s) - *Title of the article* [in] Title of the journal, Volume, Number, year, numbers of pages.

The example:

[4] Barney J. - *Organizational culture: can it be a source of sustained competitive advantage?* [in] Academy of Management Journal, Vol. 28, No. 7, 1986, pp. 56-65.

- The paper at the conference:

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The example:

[5] Bonits N. - *Intellectual Capital: An Exploratory Study that Develops Measures and Models* [at] The First Management Decision Conference, London 1998, pp. 12-20.

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The example:

[1] Specialty Publishing Group: *KMWorld Buyers Guide*. KMWorld Magazine, Specialty Publishing Group, [www.kmworld.com/BuyersGuide/Default.aspx](http://www.kmworld.com/BuyersGuide/Default.aspx) (accessed on 2011.03.15).

[2] Ridder H., McCandless A. - *Influences on the Architecture of Human Resource Management in Nonprofit Organizations: An Analytical Framework*. Nonprofit and Voluntary Sector Quarterly, doi: 10.1177/0899764008328182, 2008.

- The reference to the monograph or to an article in a language other than English.

The example:

[1] Schuster H.G. - *Chaos deterministyczny. Wprowadzenie (Deterministic Chaos. Introduction)*. Wydawnictwo Naukowe PWN, Warszawa - Wrocław 1995.

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