The Knowledge Management for Innovation Processes for SME Sector Companies

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The complexity and variability of the modern economy means that the information becomes a key resource, essential for the proper functioning of any enterprise and in the broader sense of the country and the national economy. Currently, practically all areas of modern economics are grappling with the problem of information management, both in theory and practice. It is especially visible in the attempts to support knowledge management in the areas, which are considered core from the viewpoint of increasing market competitiveness of the company. Knowledge management in the field of company's innovative potential or in the area of intellectual capital may serve as an example. This situation forces the search for new solutions of knowledge management in the field of research and evaluation of the innovative potential of companies. The main purpose of this article is to present an Internet platform for innovation audit, as a tool which supports knowledge management. An additional goal of this article is to present the preliminary results of a research carried out by means of the described tools.

Keywords: knowledge management; IT based KM system; innovation potential

Knowledge Management Based on IT Systems: Short Literature Review of the Problem Concept

Knowledge management is defined as all activities aiming at identifying, gathering, processing and making available of explicit/tacit knowledge in order to increase the efficiency and effectiveness of the company's operations (Roa, 2004, p. 23). The model describes the elements of knowledge management system as presented by J. Liebowitz (1999). All currently functioning knowledge management systems are using this model (or models with minor modifications).

Recently, knowledge management applies to all crucial areas of business activity and essentially includes the following areas (Watson, 2003, p. 31; Awad & Ghaziri, 2007):

1. Information and access to information management (support of the management process for knowledge codified in the structured or not structured databases – that is management of public knowledge).
2. Management of the organizational process knowledge.

3. Management of the company's employees' knowledge (tacit knowledge).

4. Management of the company's knowledge integration from internal and external systems.

5. Intellectual capital management (supporting the process of generating value from intellectual assets available in the company).

The debate concerning the issues of knowledge management equally focuses on the methods and techniques of gathering knowledge as well as on the technical measures utilized in this process.

The importance and significance of the modern knowledge management supporting tools is particularly emphasized in the so-called Japanese knowledge management model (SECI), created by I. Nonaka and H. Takeuchi (1995, p. 69). In the recent years, a number of models illustrating development and operation principles of the knowledge management system in a company have been created. Published models present interactions of the knowledge management system with the business processes taking place in a company.

In the model proposed by G. Probst, S. Rauba, and K. Romhardt (2002, p. 119) the following stages of knowledge management have been distinguished:

- knowledge locating,
- knowledge acquisition,
- knowledge development,
- knowledge sharing and knowledge distribution,
- knowledge usage,
- knowledge preservation.

Analysis of this model indicates the necessity of connecting the knowledge management system with the information system of the company. It is especially visible in the areas of knowledge distribution, processing and storing. Connections between the knowledge management system in a company and the IT systems are presented schematically in Figure 1. The schema illustrates the cycle of the process of the creation, storage, distribution and the implementation of knowledge (in relation to the use of IT tools). Furthermore, the schema indicates the functional areas of enterprises, which take into consideration active participation in the processes of creation and use of knowledge. Generated knowledge, thanks to methods of controlling, bears on the organizational processes in the enterprise. Effective organizational processes profitably influence the culture of the enterprise and consequently also effective resource management.
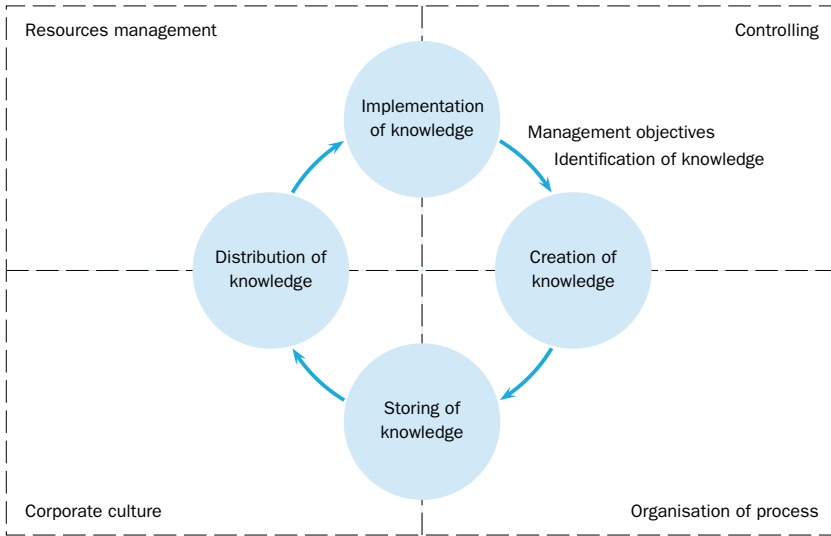
Figure 1   Significance of IT Systems in Knowledge Management

For a long time, formalized knowledge management was in fact only reserved for large companies. Meanwhile, increase in market competition and dynamic changes in companies' external environment in the recent years have also influenced small and medium enterprises to attribute great importance to the issues of knowledge management. It is especially visible in the attempts to support knowledge management in the areas, which are considered core from the viewpoint of increasing market competitiveness of the company (Chan, 2009). In the field of a company's innovative potential or in the area of intellectual capital, knowledge management may serve as an example.

Analysis of literature and practical solutions in the described scope shows that, from the perspective of knowledge management, benchmarking is an excellent source of information. The main advantage of this method is the ability to measure and compare the quantitative and qualitative characteristics of the surveyed enterprises. This allows a better understanding of the processes taking place within the company for the effective creation of knowledge.

The knowledge created in the process of benchmarking can be used in practice to improve the competitiveness of enterprises (usually by improving the quality of products and services and through the reorganization of business structures). And in the long term, thanks to the possibility of identifying best practices, knowledge created in the process of benchmarking can contribute to a precise enterprise strategy.

Supporting Knowledge Management in the Area of Innovation Potential for SME Companies: The Adopted Methodology and Research Limitations

In the area of company's innovative potential, dedicated information systems begin to play a more important role in the process of deliberate knowledge creation. IT tools allow efficient gathering of data related to the evaluation of innovative processes, and they provide an advanced tool, which allows detailed and in-depth analysis of different aspects of the innovative process stages from the company viewpoint. In addition, thanks to gathered data, such systems enable a number of benchmarking comparisons to be conducted, which may become the basis for formulating a strategy concerning the development directions for innovativeness. Knowledge management in the area of innovative potential is not only facing a problem related to the lack of effective support tools, but also the problem of obtaining adequate data to accurately describe the main determinants of innovation.

At the same time, it can be indicated that large companies have already noticed this problem long time ago and systematically modify their IT infrastructure in order to obtain as high analytical knowledge management effectiveness in the above designated areas as possible (Prahalad & Krishnan, 2008, p. 31).

Meanwhile, companies of the SME sector do not have at their disposal any dedicated tools, which directly support knowledge management in the area of the company's innovative potential. Knowledge management in the companies of the SME sector is usually based on the commonly available IT solutions, which often do not provide sufficient efficiency.

Situation described above demands a search for new solutions of knowledge management in the field of research and evaluation of the innovative potential of companies. Dedicated IT systems, which facilitate gathering and analyzing of data describing the innovative potential of companies may be a partial solution to the aforementioned problems (Falbo, Arantes, & Natali, 2004; Zanjani, Rouzbehani, & Dabbagh, 2008).

An audit of the company's innovative potential based on modern IT solutions may be an example of such a dedicated IT system. It may be a perfect tool for creating knowledge about the company's innovativeness and it may stimulate construction and improvement of the strategy in the field of innovativeness development.

At the beginning of 2009, at the Faculty of Management and Economics of Services at the University of Szczecin attempts were made to create an IT system for supporting knowledge management in the field of analysis and evaluation of a company's innovative potential.

The author of the publication formulated the following research hypothesis:

H1 *A properly designed IT system improves the efficiency of knowledge management in the area of analysis and evaluation of innovative potential of the company.*

The main research goal was to design and implement knowledge management tools to assist in the analysis and evaluation of innovative potential of the company. The following activities were performed in the framework of the research:

1. Analysis of the innovation process implemented in the enterprise.
2. Preparation of the specification and design for the knowledge management system.
3. System implementation.
4. Research of the innovative potential of enterprises using the created knowledge management system.
5. Evaluation of results.

The basic research goal was achieved through the logical induction method, which was based on the analysis of innovative abilities measurement of the small and medium businesses sector companies, and detailed analysis of the innovative process implemented in a company. The research includes all key internal determinants influencing the company's ability to implement efficient innovative activity. In the study we used a benchmarking method, which helped with comparative analyses. The research was conducted according to the model presented in Figure 2.

The created system was expected to be applicable for small and medium enterprises. We assumed that the designed system, created in the form of an audit platform, would be an easy to use, flexible and effective tool, which would support entrepreneurs in the process of gathering and analyzing data concerning the crucial areas of the company's innovative policy. Additionally, the created system was supposed to allow benchmarking comparisons of the obtained results with other data registered in the system.

The structure of an innovation audit corresponds with the analysis of subsequent phases of the innovative project's implementation process, starting from the analysis of the situation and environment of the subject, through competent search for new ideas, accurate estimation of future results, obtaining sources of financing, to an effective and efficient implementation of initiatives along with necessary control of their products and results.

The course of the innovation process in an organization, based on the adopted strategy of innovativeness, requires continuous, reliable analysis, whose results will provide reliable source for effective business decisions. It may include identification of organization's problems, development of ideas, creation of programs and projects in the area of innovations, conducting re-
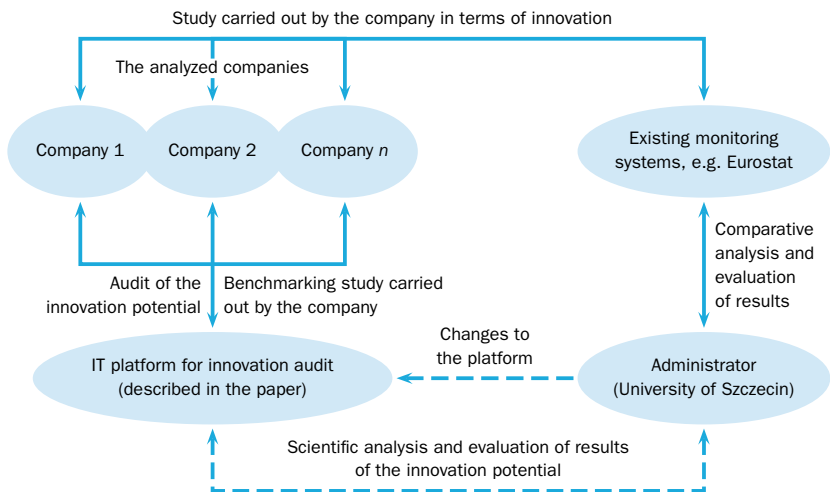
Figure 2   Research Model

search and development and improving particular process phases process in an organization and products, and evaluation of acceptance of new solutions by clients and other stakeholders.

Based on the concept of resource innovation in enterprises, the author made an attempt to identify the main determinants of the innovation potential of SMEs in Poland – factors affecting the feasibility of innovative activity. In the literature, there are many definitions of resource companies – in the context of the implementation of innovative activity. Based on the analysis of literature and research results of other authors, the paper proposes an original concept of internal resources that make up the innovative potential of enterprises; namely, the concept of creative resources that affect innovation activity. This concept is based on the functional decomposition innovation processes used in practice. Simplified diagram of the innovation process with an indication of the role of internal components of the innovation potential is presented in Figure 3.

Innovation audit process is conducted using a research survey. The questions are divided into eight categories – which correspond to the stages of the innovative process in the company and the concept of creative resources:

1. analysis of the situation inside and outside the company (cat1),
2. problem of seeking ideas for innovation (cat2),
3. the issue of planning projects in the field of innovation (cat3),
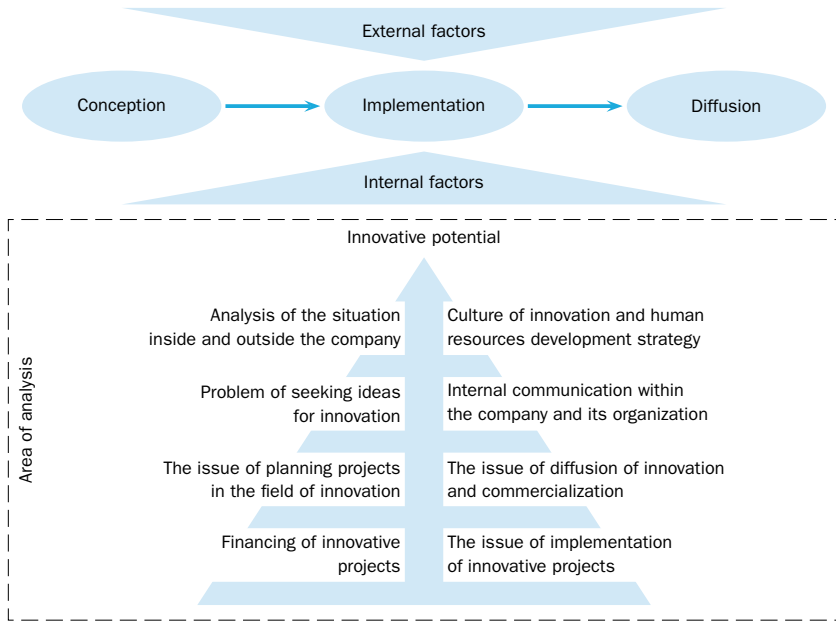4. financing of innovative projects (cat4),

Figure 3   Simplified Diagram of the Innovation Process with an Indication of the Role of Internal Components of the Innovation Potential

5. culture of innovation and human resources development strategy (cat5),

6. internal communication within the company and its organization (cat6),

7. the issue of diffusion of innovation and commercialization (cat7),

8. the issue of implementation of innovative projects (cat8).

Such research methodology is consistent with the path of implementation of the innovative process, universally described in subject literature (Vahs & Burmester, 2003, p. 144).

In the process of preparing a research tool, it was extremely important to prepare the data model. The system adopted a multi-dimensional data model dedicated to OLAP analytics. Such solution enables the advanced data analysis. Information generated across sections can be a direct source of knowledge for the process of applying for the study area. An example of an OLAP data cube is presented in Figure 4. The following dimensions (descriptive data) were proposed: company size, industries and type of innovation. Numerical data was used in the assessment of creative resources.

Technical design of this system, its rules, and basic functionality has already been the subject of other publications. This publication is deliberately
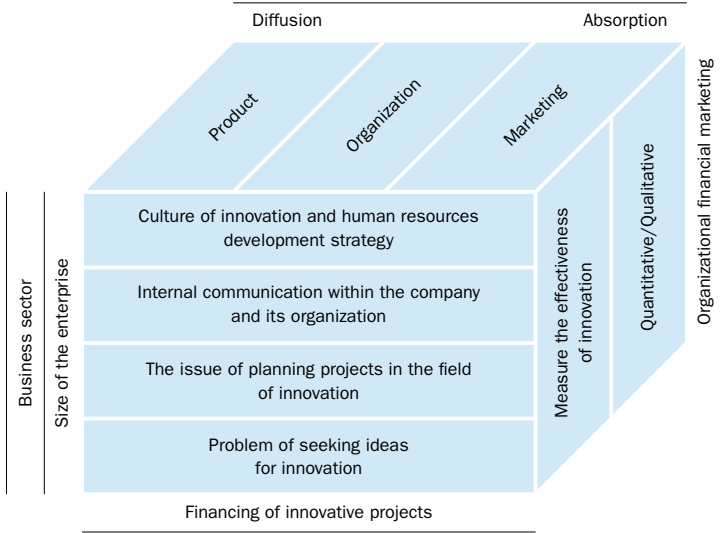
Figure 4   Used Analytical Data Model Describing the Innovative Activities
of Surveyed Enterprises

limited to the description of the data model and its benefits in the context
of knowledge management research

Preliminary Results of Empirical Research

Research of the innovation of SMEs is a key project carried out by the Faculty of Economics and Management Services US. Previously described tool
provides a series of data in order to analyze the innovation processes in an
enterprise. In the remainder of the publication, some results of the analysis
of the innovation potential of SME companies in the West Pomeranian region will be presented. The selection of firms for the research was random.
The information regarding the audit platform was sent to 3000 firms of the
SME sector. The author analyzed all firms, which voluntarily registered in
the described system.

At the moment, (as of 1 November 2012) 418 companies were registered in the system (innovation audit of the registered companies was
performed). Registered companies performed 796 audits. Companies registered in the system performed more than two thousands comparisons
with other companies (groups of companies) registered in the system.

Registered data allowed the users of the system (enterprises) to make
precise evaluations of company's innovative process potential, analyze the
company's position in comparison to selected segments of companies, and,
at the same time, evaluate competitive position in the field of innovation,
or eventually evaluate the dynamics of changes of the innovative potential

Table 1 Statistics of User Registration in the System and Statistics of Conducted Innovation Audits

(1)	(2)	(3)	(4)	(5)
1 May 2009	0	0	0	0
1 July 2009	3	3	5	5
1 September 2009	5	8	12	17
1 November 2009	6	14	9	26
1 January 2010	34	48	44	70
1 March 2010	45	93	49	119
1 May 2010	22	115	34	153
1 July 2010	0	115	18	171
1 September 2010	21	136	31	202
1 November 2010	25	161	29	231
1 January 2011	13	174	26	257
1 March 2011	19	193	45	302
1 May 2011	35	228	24	326
1 July 2011	34	262	12	338
1 September 2011	34	296	56	394
1 November 2011	21	317	49	443
1 January 2012	12	329	49	492
1 March 2012	22	351	38	530
1 May 2012	14	365	67	597
1 July 2012	26	391	54	651
1 September 2012	16	407	67	718
1 November 2012	11	418	78	796

Notes   Column headings are as follows: (1) period, (2) number of registrations, (3) aggregate number of registrations, (4) number of audits, (5) aggregate number of audits.

over time. This data provides valuable knowledge to companies concerning the formulation of a strategy of activity with regard to creating company's innovative potential and competitive position. Statistics of the number of registered users and statistics of the conducted surveys in the period from 1 May 2009 to 1 November 2012 are presented in detail in Table 1.

Data registered in the system made it possible for employees of the Faculty of Management and Economics of Services to conduct a number of researches and analyses related to the assessment of company's innovative potential at the regional level. Based on the results, the first of the hypotheses can be confirmed.

The size structure of enterprises registered in the system is as follows: micro 65%, small 31%, average 4%, and business activity structure is: 65% services, 35% production. This structure confirms the need for management expertise in the innovative potential, especially in micro and small enterprises. This is probably due to the fact that micro and small enterprises

often do not have the tools to efficiently acquire and manage knowledge in the described area. Is should also be noted that the companies performing a service, used the platform more often. This is partly due to the structure of the West Pomeranian region's economy, and also it can assumed that the services sector companies are more dedicated to seeking information about the possibility of more intensive knowledge management in the field of innovation potential.

The second hypothesis is:

H2   *Information provided via the described tools allows you to evaluate the innovative potential of the enterprise.*

In order to confirm this hypothesis, the author presents the results of the research and the benefits of scientific research findings.

Table 2 presents the aggregated values for the innovative potential of the enterprises surveyed in the analyzed areas (darker color highlights below average distribution). The table also presents the dynamics of changes in value (year 2011 compared to 2009 – data from the year 2012 was deliberately omitted because it does not represent the whole year) and calculated significance of individual characteristics (weight). Based on the analysis of obtained results it can be stated that the examined companies demonstrate the lowest internal innovative potential with regard to:

1. Innovative culture (general evaluation of this category for the whole sample is 2.23, the importance of this area was rated by respondents at 5).
2. Internal communication within the company and its organization (general evaluation of this category for the whole sample is 2.37, the importance of this area was rated by respondents at 3.0).
3. The issue of planning projects in the field of innovation (general evaluation of this category for the whole sample is 2.43, the importance of this area was rated by respondents at 3.0).
4. Financing of innovative projects (general evaluation of this category for the whole sample is 2.9, the importance of this area was rated by respondents at 5.0).
5. These areas can be simultaneously considered as the most important barriers to the development of innovativeness of Polish enterprises.
6. Such low result in these categories may be caused by the lack of experience of examined companies related to innovation, historical lack of innovation culture in Polish SME companies and continuously lasting transition of Polish economy (from centrally planned to free-market).

Table 2 Aggregate Values for the Innovation Capacity of Enterprises Surveyed

Type of business/stages of the innovation process	Aggregate Values					
	2009	2010	2011	2012	(1)	(2)
Culture of innovation and human resources development strategy	1.97	2.23	2.23	2.22	0.00	5
Internal communication within the company and its organization	2.33	2.37	2.37	2.38	0.00	3
Diffusion of innovation and commercialization	3.50	3.40	3.47	3.45	–1.96	5
The issue of innovation implementation	3.27	3.13	3.27	3.27	–4.26	4
Financing of innovative projects	3.30	3.13	2.90	2.91	7.45	5
The issue of planning projects in the field of innovation	2.50	2.43	2.43	2.41	0.00	3
Problem of seeking ideas for innovation	2.97	3.20	3.20	3.21	–3.23	4
Analysis of the situation and environment	3.30	3.23	3.67	3.65	–13.40	3
Innovative potential	2.89	2.88	2.94	2.93	—	—

Notes   Column headings are as follows: (1) the dynamics of changes 2011/2010 (%), (2) importance.

It should be noted that, in spite of a low innovative potential in most of the researched categories, the analyzed companies evaluated their own capacity with regard to transferring the results of innovative activities onto the market as very high (general evaluation of this category for the whole sample is 3.47).

A positive aspect is the fact that the examined companies, over the three analyzed years, increased the innovative potential in most of the evaluated categories, the general change of innovative potential of the examined companies amounted to 1,73%. In the analyzed period (2009–2011), the examined companies increased the innovative potential the most with regard to innovative culture (change by 13,56% between the first and the third research) and with regard to the analysis of the situation and environment (change by 11,11% between the first and the third research). However, the biggest decrease in the potential of the examined companies occurred in the category of financing (change by –12.12% between the first and the third research) and in the category The issue of planning projects in the field of innovation (change by –2.67% between the first and the third research) – which may also be explained by a reduced availability of financial funds for innovative activities.

Among the examined companies, a higher innovative potential can be seen in production companies rather than in service companies. When analyzing the size of the companies, it may be concluded that medium companies have a much larger innovative potential. The result analysis indicates that the lowest internal innovative potential can be seen in micro and small

service companies. Medium production companies have the highest innovative potential.

The author also examined the strength of the correlation between the determinants of innovation capacity. This allowed the assessment of the mutual influence of each variable. The author conducted a correlation analysis for all eight areas studied – correlation analysis was performed using SPSS software (Pearsons correlation test). The analysis showed that the largest (strongest) effect on other variables was exerted in the following areas:

1. innovative culture,
2. financing of innovative projects.

A taxonomic cluster analysis conducted by means of SPSS package (supporting statistical analysis), which demonstrated the existence of three main groups of examined companies:

1. not innovative companies,
2. companies developing in terms of innovative potential,
3. leaders of innovative potential.

For the creation of innovative activity models for examined companies the Author applied the agglomerative clustering method based on the closest neighborhood, the group average method and the Ward method. The author took into consideration the number, significance and intensity of the features describing the innovative potential of the examined companies and deliberately applied three methods of taxonomic clustering (in order to achieve comparability of results). Such constructional assumption regarding the created models is correct from the econometric point of view and provides the data required for the creation of the innovative activity models of companies and for the inference. The presented taxonomy results and the consequent descriptive models of innovative activity of the examined companies only consider the data of the full year of research period, namely the year 2011 – data from the year 2012 have been deliberately omitted because it does not represent the whole year. The presented descriptive models provide the general characteristics of innovative activity of the examined companies. Table 3 presents the overall results of clusters analysis.

The first group (61%, namely 256 of the examined companies) consists of the companies with their potential definitely below the average potential as compared to the examined companies. This group may be identified as not innovative. This group includes, first of all, micro and small service companies and micro production companies. Companies in this group

Table 3 The Results of Clusters Analysis

Type of business/stages of the innovation process	(1)	(2)	(3)
Culture of innovation and human resources development strategy	1.3	3.8	4.3
Internal communication within the company and its organization	1.8	3.0	4.3
Diffusion of innovation and commercialization	2.4	3.8	4.0
The issue of innovation implementation	2.5	3.3	4.2
Financing of innovative projects	2.8	3.3	4.1
The issue of planning projects in the field of innovation	1.8	3.4	4.3
Problem of seeking ideas for innovation	2.4	3.7	4.0
Analysis of the situation and environment	2.8	3.4	4.0
Aggregate innovative potential	2.2	3.5	4.2
Numbers of companies in the group	256	91	37
	(61%)	(22%)	(9%)

Notes Column headings are as follows: (1) non innovative companies, (2) developing companies, (3) leaders of innovative potential.

have low innovation culture; they practically do not conduct organized and formalized innovative activities with regard to analyzing the situation and environment, searching for ideas for innovative activities or implementing innovative projects.

The companies of this group reveal very low tendency to take a risk. Profits of this group of companies result from innovative activity to a very small extent and the innovations introduced by these companies are usually seeming and imitative (or there is a complete absence of innovative products or services).

The companies from this group hardly assign any financial means (either own or external in the form of e.g.: bank loans or available subsidies for the development of innovativeness) for the implementation of their innovative activity, very seldom they cooperate with other market participants (companies, research centres or institutions from business environment).

The companies from this group are not able to make a precise evaluation of own innovative potential, of the results of own innovative activity, and they do not pursue their future in the field of market innovation introduction; they declare the limitation of their activity exclusively to the basic scope of activity – which indicates closure to innovativeness.

The second group (22%, namely 91 of the examined companies) is a group of companies that demonstrate innovative potential on the border of the average value of particular distributions with an increasing trend. This group includes mostly small and medium companies conducting mainly production activities. This group may be identified as a group of companies developing in terms of internal innovative potential. Companies from this group demonstrate the largest potential with regard to evaluating and planning in-

novative projects, analyzing the situation and environment, and searching for ideas with regard to innovation.

Unfortunately, the companies from this group frequently have problems with financing innovative undertakings, which may be explained with innovation market facilitation problems (which is a common feature with the companies described as non-innovative).

The companies from this group often reveal unsatisfactory experience in the scope of of innovative undertakings implementation (lack of the ability to cooperate with other market participants) and the lack of the ability to analyze and evaluate own innovative activities.

The companies of this group gradually increase their innovative culture, they try to formalize their innovative activity (with human resources development, formalizing the knowledge management in the company and constructing company structures responsible for the implementation of innovative projects) and actively try to procure means (especially external) for financing the implementation of innovative projects. The companies from this group are characterized by the openness to ideas and relatively high ability to take a risk related to the implementation of an innovative activity (which is a common feature of the group of innovativeness leaders).

The companies from this group almost unambiguously see their future in conducting innovative activity as well as undertaking actions aiming at improvement of their innovative potential, but they seldom have precisely determined directions of own innovative activity development.

The third group (9%, namely 37 of the examined companies) consists of companies with high potential as compared to the analyzed group and is characterized by high innovation culture. Companies from this group often introduce innovations on a trade scale. This group may be called the leaders of innovative potential in the Polish SME sector. This group includes mainly medium companies conducting production activities. These companies demonstrate a higher innovative potential in all categories when compared to other examined companies.

The companies from this group gain large profits (market facilitation) with the sale of innovative goods and services, reveal high innovative awareness and culture, and attach importance to organized and planned innovation management (searching for ideas in scope of innovations, implementation of innovative ideas or the ability to measure and evaluate the efficiency of own innovative activity) and to the development of human resources related to the implementation of the innovative processes.

The companies from this group have funds in their budget assigned to the performance of innovative activity and reveal extensive activity in procuring external financial means for the implementation of innovative projects. The companies from this group reveal extensive ability to undertake inno-

vative projects and they widely cooperate in scope of innovativeness with other market participants and research institutes. The companies from this group explicitly pursue their future in the field of introduction of innovative goods and services to the market and have precisely defined directions of developing own innovative activity.

This indicates the presence of large polarization between a leader of innovation and developing companies in relation to not innovative companies. Additionally, this situation may cause perpetuation of innovative models of implementation activity – which is highly unfavorable in the case of not innovative companies.

Based on the results, the second hypothesis can be confirmed.

Conclusion and Recommendations for Further Research

The conclusions of the study can be broadly divided into two areas; namely, the description of the proposals for a tool to support knowledge management; current capabilities and future direction of the development of the system. The second area consists of the requests for the data obtained and, in particular, their values in the process of scientific research.

A large interest in the platform stimulates employees of the Faculty of Management and Economics of Services to continue the research and development work related to the system. While some of the planned changes and implementations of the system's subsequent modules are own ideas of the department's employees, others are the consequence of the comments and suggestions reported by current users of the platform.

At the present time, works related to the development of a graphic presentation module of the gathered data are in progress – the system will present predefined indicators describing innovative potential of a region in a tabular form and in a form of graphs. Users of the system will also be allowed to create their own sets of indicators and subject them to observations.

Another planned step related to the extension of the described audit platform is the system of monitoring and automatic notification of users regarding the changes in the area of crucial indicators. This module will – according to the user's definition – monitor defined groups of indicators and will notify the user of the platform in case of changes (threshold value of change which the system will react to will also be defined by user). In the future, authors also plan the implementation of a module presenting gathered data on maps – this will enable effective and transparent analysis and evaluation of a company's innovative potential in a geographic perspective.

First researches completed by the presented system indicate that this is a very effective tool, which has a significant impact on supporting knowledge management in the field of gathering and processing information concern-

ing crucial areas, which create innovative potential, and conducts precise evaluations of company operations. An additional positive aspect of the created system is that it supports scientific research in the field of companies' innovation. The author examined the opinion of the firms using the described system; namely the following features: the operating comfort of the system, the utility of the delivered information, and the efficiency of the system. 82% of the users evaluated the system (general mark) as very good and 11% users evaluated the system as good. Such result permits to describe the system as a perfect tool.

Data provided by the described system enables research of the enterprise innovative potential. The big advantage is the ability to analyze the dynamics of the processes (comparison period to period) and compare these with each group of selected companies (benchmarking). It seems that further development of the system will be to increase the amount of data recorded by the system (the development of measurement tools). This will allow a wider range of conduct analyses and in-depth analyses. In the author's opinion it is also necessary to compare the results of the research with the results of other authors (or the results published on the basis of publicly available data, eg EUROSTAT).

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