Justyna Patalas-Maliszewska[1]
Institute of Computer Science and Production Management/ Institute
for Software Technology and Interactive Systems
University of Zielona Góra/ Vienna University of Technology
j.patalas@iizp.uz.zgora.pl

STRATEGIC KNOWLEDGE MANAGEMENT IN AN INNOVATIVE SME SECTOR COMPANY AS AN EXAMPLE OF DEVELOPMENTS IN ORGANIZATIONAL STRUCTURES

1. Introduction

Although a lack of conformance in the process of defining "innovation" has been recognized [2] there has been no embracement of any consistent dimensions of these constructs. Nowadays, the notion of innovation is treated flexibly depending on the field in which it is used. The concept of an innovative SME sector company (small and medium-sized enterprise) used in this article requires further explanation. Firstly, innovation is considered to be an essential strategic index for a company in the

[2] R.K., Chandy, G.J. Tellis: The incumbents curse - incumbency, size, and radical product innovation", Journal of Marketing 2000, Volume: 64, pp. 1-17; S.G.,
M.B. Green Gavin, L. Aiman, B.L.R. Smith, Assessing a multidimensional measure of radical technological innovation", IEEE Transactions on Engineering Management 1995, Volume: 42, Issue: 3. pp. 203-214;
B.L.R., Smith, C.E..Barfield , Technology, R&D, and the economy, The Brookings Institution 1996, Washington, DC.

process of developing and maintaining a competitive edge in the market. Secondly, strategic-knowledge management should be considered as a method of building strategic capacity.

Describing strategic-knowledge management is necessitated by the concept of resource management [3] and by competence management[4].

Treated as a subdivision of knowledge management, competence management deals with the knowledge of individuals, i.e. their competencies. On the micro level, led by human-resource management, the focus lies on the competencies of the individual employee.

Resource management deals with resources. According to a resource-based view, whether or not an organization gains a competitive advantage and any associated returns depends on the strategic planning used to leverage those resources[5].

Thus, the following research problem has been formulated:

There is an innovative SME sector company with a defined functional area and business process. There is a set of values of the strategic knowledge resource of the given company. What is needed is a model, which will allow for the following question to be answered: Is it possible to find strategic-knowledge resources in an SME that will enable an SME-sector company to achieve a desired level of innovation?

The aforementioned problem can be presented in the form of a task:

[3] D.G. Sirmon, M.A. Hitt: Managing resources: linking unique resources, management and wealth creation in family firms, "Entrepreneurship Theory and Practice", 2003, Vol. 27, no. 4, 2003, s.339-358.

[4] G. Berio, M. Harzallah, Knowledge management for competence management. Journal of Universal Knowledge Management, 2005, 0(1):21–38.

[5] R. McGrath, I. MacMillan, The entrepreneurial mindset. Boston: Harvard Business School Press, 2000.

The available information: the characteristics of an SME-sector company with a defined area of operation and a defined strategic-knowledge-resource value. The answer to the following question is being sought: Is there such an algorithm which will enable us to connect the ideas of the qualifying criteria for an innovative SME sector company together with the value of a strategic-knowledge resource?

This article has put forward this question in order to develop the concept of strategic-resource-management in an innovative SME sector company.

2. An Innovative SME-sector Company

The innovation potential of a company is essentially the ability to implement innovation effectively (new products, technology, organisational methods, marketing innovation[6] . There are two types of innovation potential: internal (which includes the company resources), external (which includes resources from outside of the company but which are available to the company).

Innovation is not a guarantee of success, it is a chance. …leading companies develop the wallet of innovation, which others can take from in order to sustain their own growth[7]. Innovation capability refers to the ability to make major improvements and modifications to existing technologies, and to create new technologies[8].

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[6] K. Poznańska, Innovations in the small and medium sizes enterprises", *Warsaw1998 (in Polish).*
[7] T. Davila, R. Epstein, R. Shelton, Making innovation work: How to Manage It, Measure It and Profit From It, Wharton Scholl Publishing, 2005.
[8] J.L. Furman, M.E. Porter, S.Stern, The determinants of national innovative capacity, Research Policy, Volume: 31, 2002, pp. 899-933;
H. Romjin, M. Albaladejo, Determinants of innovation capability in small UK firms: an empirical analysis, Working Paper No. 40, University of Oxford, Queen Elizabeth House, 2000.

By definition, an innovation index (function) is a concise quantitative indicator of the innovative capability of institutions, researchers, businesses and territories in the selected areas of research[9]. To put it another way, it is a tool to measure, monitor and promote progress of the innovation performance. The index (function) could also serve as a quantitative benchmark of capability highlighting the resource commitments and policy choices that mostly affect innovative output in the long run[10]. International Institute for Management Development (IMD) and World Economic Forum (WEF) are the two major global organisations developing the science, technology and innovation capability indexes. Many studies (e.g. the studies of innovation index by IMD, WEF, OSLO Manual, Commission of the European Communities, INSEAD) take into account various aspects of innovation in strategic human resource management in company.

On the basis of an analysis of the literature on the subject, and through observing economic reality, the following quantitative qualification criteria have been defined for an innovative SME sector company (see Tab. 1):

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[9] Aspen Institute Italia, National Interest: The Showcases of Excellence. Aspen Institute Italia, 2007.

[10] M.E. Porter, S. Stern S., The New Challenge to America's Prosperity: Findings from the Innovation Index, Council on Competitiveness, 1999, USA;
M.E. Porter, Clusters and Competition: New Agendas for Companies, Governments, and Institutions, on Competition, 1998, Harvard Business School Press, Boston, MA.

Table 1: The quantitative qualification criteria described An Innovative SME-sector Company

The quantitative qualification criteria described An Innovative SME-sector Company (c_i, $i \in N$)	Weight (w_i, $i \in N$), $\sum w_i = 1$
c_1 - The share of new products and technologies in relation to the annual value of sales in the company,	0,18
c_2 - The number of new products launched in a particular year (within the last 5 years),	0,13
c_3 - The number of new technologies implemented in a particular year (within the last 5 years),	0,18
c_4 - The number of completed research tasks,	0,02
c_5 - The number of patents,	0,03
c_6 - The amount of capital designated for research in relation to the value of sales in a particular year,	0,04
c_7 - The share of strategic products in the national market,	0,04
c_8 - The number of employees who hold degrees,	0,06
c_9 - The number of employees with a higher-education in relation to other employees,	0,2
c_{10} - The number of scientific publications	0,02
c_{11} - The number of awards obtained in contests or competitions,	0,07
c_{12} - The number of sold licences,	0,01
c_{13} - The number of implementations,	0,01
c_{14} - The number of purchased and used external licences.	0,01

Thus, the essential strategic index, which describes an innovative SME sector company is defined:: $I_{SMEs} = \sum_{i=1}^{n} w_i c_i$,

where $i \in N$ and

w_i – weight of quantitative criteria for an innovative SME sector company,

c_i – value of quantitative criteria for an innovative SME sector company.

On the basis of the literature of the subject, it has been established that the innovative abilities of a company are largely dependent on the knowledge of its employees. This knowledge is strongly influenced by the quality and type of the formal education that the employees have had. Intellectual capital plays a special role in the process of innovation. In relation to other innovation factors, the intellectual capital factor is:

- complete (it determines the ability to create, adapt and implement innovation: both national and foreign sources),
- non-substitutional (in marketing or organisational innovations),
- substitutional (after the introduction of topical innovation, a less-qualified labour force is replaced by a better-qualified one).

In the aforementioned context, an attempt has been made to build a model which would enable the connection of the qualifying criteria for an innovative company to the value of a strategic-knowledge resource.

3. Strategic-knowledge Management in an Innovative SME Company

    3.1 Strategic knowledge resource in An Innovative SME-sector Company

While resources are important to a firm's performance, according to resource-based view, whether an organization gains a competitive advantage and the associated returns depends on the strategic planning used to

leverage those resources[11]. Describing a strategic knowledge resource is motivated also by the concept of resource management[12] and by competence management.

Author define the strategic knowledge resource in a company as the so called usefulness personnel function within that company. So, the value of strategic knowledge resources for the m-th employee in a company is defined as the value of the personnel usefulness function W_{nm} encompassing a synthetic index for the m-th employee in the n-th functional area in a company[13].

$$W_{nm} = f_1(GK) + f_2(PK) + f_3(A) + f_4(E) + f_5(P) + f_6(C) + f_7(P),$$

where: $n, m \in N$,

- $f_1(GK)$ – the general knowledge function for the m-th employee in SME, where: $GK \in R$, and $0 \le f_1(GK) \le 5$,

- $f_2(PK)$ – the professional knowledge function for the m-th employee in SME, where: $PK \in R$, and $0 \le f_2(PK) \le 5$,

[11] R. McGrath, I. MacMillan, The entrepreneurial mindset. Boston: Harvard Business School Press, 2000

[12] D. Sirmon, M.A. Hitt, Managing resources: Linking unique resources, management and wealth creation in family firms. Entrepreneurship Theory and Practice, 2003; G.Berio, M. Harzallah, Knowledge management for competence management. Journal of Universal Knowledge Management, 2005, 0(1):21-38.

[13] J. Patalas-Maliszewska, The concept of system supporting decision making enabling to asses and forecast of knowledge in SMEs – research results. Applied Computer Science, Zilina, Slovak Republic, 2009, pp. 27-42.

- $f_3(A)$ – the professional abilities function for the m-th employee in SME, where: $A \in R$, and $0 \leq f_3(A) \leq 5$,

- $f_4(E)$ – the experience function for the m-th employee in SME, where: E – is a synthetic index of experience for the m-th employee in SME binding the factors di: $E = \dfrac{\sum\limits_{i=1}^{3} di}{3}$ where: d1- year of work, d2- age of employee, d3- number of realized project. Each indicator $f_4(E)$ is assessed on the points scale $(0-5)$ and $0 \leq f_4(E) \leq 5$,

- $f_5(P)$ – the patents function for the m-th employee in SME, where: P - synthetic index of patents for the m-th employee binding the factors ei: $P = \dfrac{\sum\limits_{i=1}^{4} ei}{4}$ where e1- number of patents, e2 - value of investment of new patents, e3 – value of copyright, e4- number of project, which are waiting for patents. Each indicator $f_5(P)$ is assessed on the points scale $(0-5)$ and $0 \leq f_5(P) \leq 5$,

- $f_6(C)$ – the clients function for the m-th employee in SME, where: C - synthetic index of clients for the m-th employee binding the factors ki: $C = \dfrac{\sum\limits_{i=1}^{3} ki}{3}$ where: k1- number of all clients, k2 - number

of permanent clients, k3– number of transactions. Each indicator $f_6(C)$ is assessed on the points scale $(0 – 5)$ and $0 \leq f_6(C) \leq 5$,

- $f_7(P)$ – the m-th employee's personality in SME, where: $P \in R$, and $0 \leq f_7(P) \leq 5$.

The value of each parameters of function $\mathbf{W_{nm}}$: $f_1(GK)$, $f_2(PK)$, $f_3(A)$, $f_4(E)$, $f_5(P)$, $f_6(C)$, $f_7(P)$ and the value of $\mathbf{W_{nm}}$ for each m-th employee in SMSs we can receive based on the results of tests completed by the employee in F_n-functional department in SMEs. Tests at the current level of research are formulated for the sales department in SME sector company in line with the defined reference model[14]. After completing the tests the employee sales business owner or manager has access to synthesized information:

- Whether m-th employee placing your data will appropriate job,

- What is the value of the personnel usefulness function: $\mathbf{W_{nm}}$ for the m-th employee,

- What is the value of individual components of the personnel usefulness function: $\mathbf{W_{nm}}$ for the m-th employee.

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[14] J. Patalas-Maliszewska, H. Werthner, Methodology of knowledge value assessment in an enterprise of SME sector. Management and Production Engineering Review, vol. 1, no 1,2010, pp. 21-28.

It is possible to receive indispensable data for account of value personnel usefulness function from companies by interview in each enterprise.

3.2 The Concept of Strategic-knowledge Management in an Innovative Company

The formulated research problem of seeking an algorithm which will enable the connection of the qualifying criteria for an innovative company to the value of a strategic-knowledge resource is an issue of decision making. The solution may be presented in the form of the following tasks: (1) the possibility of an objective: (a) the reference model for SMEs: the functional areas of the companies, the structures of business processes related to those areas, (b) the values of strategic-knowledge resources within a given SME, (c) the value of the essential strategic index which describes an innovative company, (2) the possibility of the assessment of the level of innovation in an SME depending on the value of strategic-knowledge resources in that SME.

In order to solve the research problem, a polynomial decision-making model has been designed: it consists of three elements: (1) a base of the values of strategic knowledge resource and the value of strategic

essential index, which describes an innovative company, (2) a GMDH algorithm, (3) an analyzer of a logical model and an answer generator.

GMDH is a modeling algorithm based on processing empirical data. GMDH was created by linking elements of the least squares method and Gödel's theory, which supplement a procedure for the synthesis of the hierarchical Ivachnienko's polynominal. GMDH was initially used for the precise prediction of the development among fish population in rivers and oceans. The main idea of the algorithm was a synthesis of the polynominal model. Because of the integration of structural and parametriocal optimisation concepts, Ivachnienko's polynominal, resulting from the GMDH procedure, turned out to be a model ensuring precision and practical application[15]. The basic assumption of the algorithm was to eliminate a deductive approach based on engineers' and experts' knowledge. Another important element was the idea of polynominal evolution from its elementary structure to the optimised one through selecting various combinations of simple partial models.

Therefore, the concept of strategic-knowledge management in an innovative company is proposed:

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[15]A.G. Iwachnienko, Induktiwnyj metod samoorganizacji modelej sloznych system po eksperymentalnym danym, Kijów: Naukowa Dumka, 1982.

Stage 1:

The need for innovation implementation in an SME according to the reference model.

Stage 2:

Analyzing strategic-knowledge resources in the SME - determining the personnel usefulness function values for each m-th employee in an SME (each m-th employee has to complete the "author's test").

Stage 3:

Analyzing the level of innovation in the SME - determining the value of the essential strategic index:

$$I_{SMEs} = \sum_{i=1}^{n} w_i c_i,$$

where $i \in N$ and

w_i – weight of quantitative criteria for an innovative company,

c_i – value of quantitative criteria for an innovative company.

Stage 4:

Results of the analyses - Database of personnel-usefulness function values for each m-th employee in an SME, and of the value of the essential strategic index.

Stage 5:

Configuring the connection of the essential strategic index which describes an innovative SME company in relation to the value of its strategic-knowledge resources - using GMDH method: the *Innov* decision-making model:

$$I_{SME} = A_{pq} + B_{pq}x_p + C_{pq}x_q + D_{pq}x_p^2 + E_{pq}x_q^2 + F_{pq}x_px_q$$

I_{SME}– value of essential strategic index which describes an innovative SME company,

x_p, x_q – the value of the strategic-knowledge resource in an SME,

A_{pq} – the value of estimators.

Stage 6:

Determining the connection of the essential sstrategic index which describes an innovative SME company in relation to the value of its strategic-knowledge resources - using the *Innov* model: forecasting the level of innovation in an SME depending on the value of strategic-knowledge resources in that SME.

Stage 7:

Making a decision about innovation implementation or changing the strategic-knowledge resources in an SME.

In further work, the research results of the use of this concept will be carried out.

Conclusion

How innovations are labeled is important if researchers want to increase their understanding of the development processes of different types of innovations. The goal for future researchers should be to help practitioners identify the value of knowledge in a company.

This article has addressed the essential strategic index in knowledge management as a key instrument in building capacity and helping to enhance a company. The article presents a decision-making model for a set of strategic-knowledge resources in an enterprise. In further work, a verification of the accuracy of the forecast of the values of strategic-knowledge resources will be carried out.

The results of this study offer important implications for researchers and practitioners of firms. The results suggest that future research, investigating the effectiveness of strategic-knowledge-resource management in firms, will allow companies to build a sustainable competitive advantage based on knowledge.

Abstract: The growing interest and research into the concept of strategic-knowledge resource management in an innovative SME company has led to a proliferation of diverse definitions and perspectives, as well as a number, however limited, of empirical studies. The question is what role does staff play in innovation? Ever since it was argued that staff can also be sources of innovation, the literature on the role of staff during innovation has grown tremendously.

In the proposed article, the author will present the concept of strategic-knowledge management in an innovative company while assessing the current state of the literature on the issue. An innovative SME company and the strategic-knowledge resources within an SME are strictly defined. Consequently the GMDH algorithm is proposed as an algorithm which will enable the connection of the qualifying criteria for an innovative company to the value of its strategic-knowledge resources (the *Innov* decision-making model).

Streszczenie: W literaturze przedmiotu wyróżnia się liczne opracowania dotyczące obszaru zarządzania wiedzą w innowacyjnych małych i średnich przedsiębiorstwach. W artykule przeprowadzono analizę literatury przedmiotu i jednoznacznie wskazano na niszę w obszarze zdefiniowania korelacji pomiędzy strategicznymi zasobami wiedzy a poziomem innowacyjności w przedsiębiorstwach sektora MSP. Zaprezentowano nową koncepcję strategicznego zarządzania wiedzą w innowacyjnych przedsiębiorstwach sektora MSP. Ściśle zdefiniowano innowacyjne przedsiębiorstwo oraz sformułowano definicję strategicznych zasobów wiedzy. W konsekwencji zaproponowano model decyzyjny Innov, który pozwala na określenie wartości wiedzy w firmie i poziomu innowacyjności przedsiębiorstwa.