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The Method for Assessing and Forecasting Value of Knowledge in SMEs – Research Results[1]

Submitted: June 24th, 2010 **Accepted:** September 22nd, 2010

Summary

Decisions by SMEs regarding knowledge development are made at a strategic level (Haas-Edersheim, 2007). Related to knowledge management are approaches to "measure" knowledge, where literature distinguishes between qualitative and quantitative methods of valuating intellectual capital. Although there is a quite range of such methods to build an intellectual capital reporting system, none of them is really widely recognized. This work presents a method enabling assessing the effectiveness of investing in human resources, taking into consideration existing methods. The method presented is focusing on SMEs (taking into consideration their importance for, especially, regional development). It consists of four parts: an SME reference model, an indicator matrix to assess investments into knowledge, innovation indicators, and the GMDH algorithm for decision making. The method presented is exemplified by a case study including 10 companies.

Introduction

Knowledge management is promoted as an important and necessary factor for organizational survival and maintenance of competitive strength. Organizations need a good capacity to retain, develop, organize, and utilize their employees' capabilities (Brennan and Connell, 2000). Liu suggested that taking advantage of the knowledge

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[1] This work was supported by the Community under a Seventh Framework Programme – People, Marie Curie Intra-European Fellowship for Career Development: "SKnowInnov (Nr: 235585)".

management could excite employee potential and accelerate the integration of employee knowledge (Liu et al., 2001). Knowledge management has become one of the necessary conditions for enterprises to survive in a competitive environment. Davenport and Prusak stated that knowledge management involves collecting and organizing information and transferring information to those that need it (Davenport and Prusak, 1998). Drucker stetted that "for each type of organization, transformation into an information-oriented organization is the best" (Drucker, 2000).

Hence, we define knowledge as improving qualifications and skills among employees in SMEs. As regards research, the status of knowledge includes methods of intellectual capital assessment based on investment in staff's knowledge development. However, there are no methods assessing the efficiency of decisions on acquiring knowledge. Literature distinguishes qualitative measures (e.g. Danish project of IC measurement, 'Scandia' navigator, intangible assets monitor, IC model – TM Rating, VCSTM, balanced result sheet, report by Saratoga Institute) and methods of valuating intellectual capital (e.g. MV/MB, q-Tobin, CIV, KCE, VAIC™, economic added value (EVA™), IAV model, Strassmann's method, IAMV™, technology broker) (Dudycz, 2005; Edvinsson and Malone, 1997; Fitz-enz, 2001; Kasiewicz et al., 2006; Mikuła et al., 2002; Nonaka and Takeuchi, 1995; Szczepankowski, 2006).

Attempts are made continuously to find methods for measuring intellectual capital and still there is no widely accepted recognized method enabling to build an intellectual capital reporting system. The difficulty is that the majority of the concepts are prepared for specific companies, in other words, such measuring methods are tailor made and their general application is not possible (Patalas-Maliszewska and Krebs, 2009).

Because of the niche in the area of concepts assessing and forecasting value of knowledge in SMEs, this research focuses on the creation of a method of assessment and prediction of the value of knowledge in SME. The following research problem was formulated. There is a defined enterprise in the SME sector: the certain business processes in specific functional departments. There are employees of SME on certain work, who follow defined business processes. Is it possible to describe the value of knowledge of a given employee in the enterprise? Is there a method of assessing and predicting the knowledge value in the enterprise of SME sector?

The structure of the paper is as follows: The second chapter provide an overview of the methods of evaluating profitability of investments in the intellectual capital, known from a literature. The third charter presents the author's method for assessing and forecasting value of knowledge in SMEs (Patalas-Maliszewska and Krebs, 2009).

Through case study (values of personnel usefulness function in 10 companies) we show how using the matrix to assess investment in knowledge. Consequently the concept of building the model supporting decision making that enables the assessment and forecasting of knowledge in SME is created. Finally, the summary presents directions of further works.

1. Background and related work

In intellectual capital management theory and in economical practice, it is noticed that there is a continuous search for measurement methods of intellectual capital (IC). However, there is still no overall recognized method which use might solve initially drawn problems concerning enterprise's IC value assessment and report system of intangible assets.

In management theory as well as in economical practice there are many suggestions of methods of measurement for intellectual capital. Many suggested concepts of measurement of intangible assets did not lead to formulating unambiguous method of assessment of the intellectual capital value in enterprises. These methods can be distinguished in qualitative and quantitative methods of valuating intellectual capital. The following qualitative measurements of the intellectual capital were presented (Mikuła, 2002; Kasiewicz et al., 2006; Nonaka and Takeuchi, 1995; Edvinsson and Malone, 1997):

- The Danish Project of IC Measurement,
- The Skandia Navigator,
- The Intangible Assets Monitor – IAM,
- The IC – Rating™ Model,
- VCS™,
- Balanced Scorecard,
- The Value Explorer™ Model,
- Saratoga Institute Report,
- Human Capital Index (HCI).

And the following quantitative measures of valuating intellectual capital were indicated (Mikuła, 2002; Kasiewicz et al., 2006; Nonaka and Takeuchi, 1995; Edvinsson and Malone, 1997; Szczepankowski, 2006):

- MV / MB Indicator,
- CIV Indicator,
- KCE Indicator,
- VAIC™ Method,
- Economic Value Added,
- IAV (Intangible Assets Valuation) Model,
- Strassmann's Method,
- IAMV™ Model,
- Broker's Technology.

Since all these methods show specific shortcomings (Fitz-enz, 2001), in the following we present our approach to assess the effectiveness of investing in human resources; consisting of four elements:

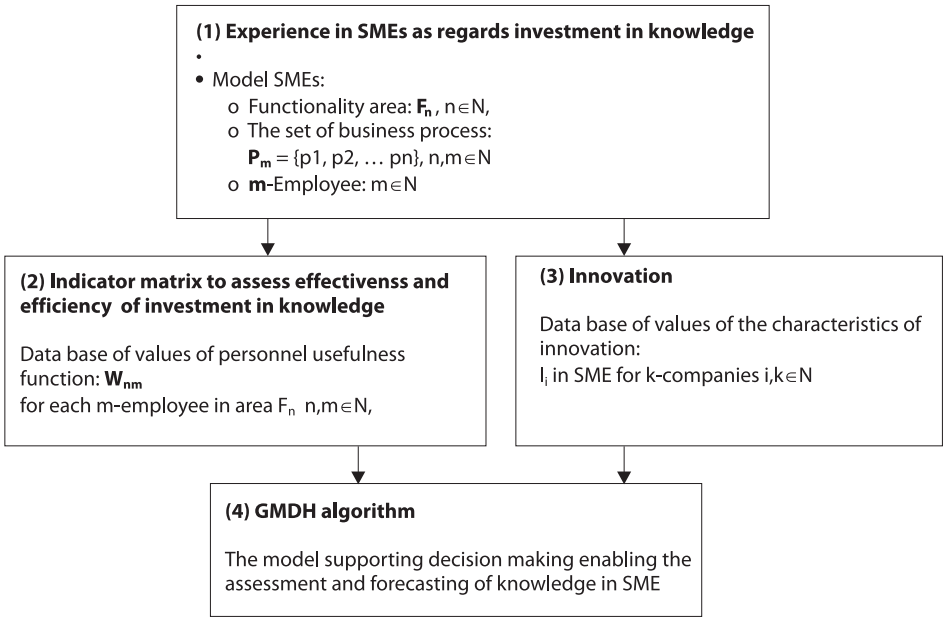
1. Experience in SMEs as regards investment in knowledge: research results (the sets of business processes are created for m-th employee in the n-the functionality area on example sale area in SMEs).
2. Indicator matrix to assess the effectivenss and efficiency of investment in knowledge: research results (value of personnel usefulness function from 10 companies – see chapter: "Indicator matrix to assess effectiveness and efficiency of investment in knowledge").

3. Innovation: values of the characteristics of innovation in SME – research are focused of literature studies concerning the concept of innovation transfer process in SME and data collection from SME about value of characteristics of innovation.
4. GMDH algorithm (Farlow, 1984; Iwachnienko, 1982).

2. The method for assessing and forecasting value of knowledge in SMEs – "SKnowInnov method"

In this section we present an overview of the SKnowInnov method of strategic knowledge management in SMEs (see: Figure 1).

Figure 1. The method of strategic knowledge management in SMEs – "SKnowInnov method"



Source: own study.

In the rest of this section we will look at the first and second part of the method of strategic knowledge management in SMEs, whereas the other parts are described in the paper (Patalas-Maliszewska and Krupa, 2009).

3. A reference SME model

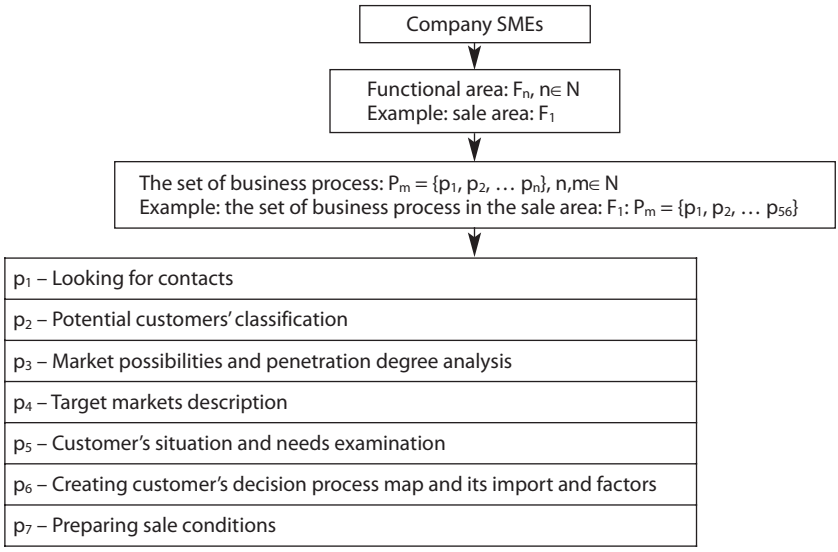
In economy practice making a decision in enterprise is also conditioned by competitors' action, changing factors of environments, eg. technical progress and results of the research works (Haas-Edersheim, 2007). In this context an added value for SME can be determined as knowledge, employees' skills and abilities, social relation, know-how, and, particularly, effective investing in intellectual capital. The enterprises which invest in human capital and systems of work may achieve competitive advantage because of theirs workers' readiness to learning and qualifying themselves and also thanks to effective information and transfers.

So, let us define the reference SME model enabling to assess knowledge in SME. The SME model proposed is based on literature review and own scientific research (Kasprzak, 2005). It involved a survey of selected SMEs, focusing on the sales area. The research group consisted of 10 companies.

A so called the business processes were defined in detail for each division of the company. It refers to the definition of SMEs (see: Figure 2) (an SME according to the regulation dated November 12, 1999, Commercial Law – Dz.U. Nr 101, poz. 1178) and includes the following business processes, employees (description of workplaces), and so called a personnel usefulness function. The business processes in each functional areas in SME describe employees activities. The personnel usefulness function is defined for each employee, which realizes the determined set of business processes.

Based on the research results in the companies the sets of business processes are described for employees in the specific functional areas (such as the sales area – see: Figure 2):

Figure 2. A reference SME model: set of business process example on the sale area



p_8 – Establishing organisation people who influence purchase decisions
p_9 – Establishing customer contacts type
p_{10} – Searching and describing potential customers
p_{11} – Providing clients with information on company's products and services
p_{12} – Commissioning advertising in media
p_{13} – Developing setting and graphic form of an advert in media
p_{14} – Direct talks with a client in company's premises
p_{15} – Direct talks with a clients in client's premises
p_{16} – Telephone conversations with a client
p_{17} – Developing products/services presentation and offer
p_{18} – Drives to a customer
p_{19} – Informing about product's qualities
p_{20} – Comparing company's offers with competitive offers
P_{21} – Co-operation in solving customer's problems
p_{22} – Persuading, negotiating and setting sales conditions
p_{23} – Formulating proposals in writing and creating documentation
p_{24} – Presenting final offer
p_{25} – Finalising transaction
p_{26} – Writing orders and complementary orders
p_{27} – Registering order for a supplier
p_{28} – Purchase registering
p_{29} – Sales and delivery registration
p_{30} – Invoicing
p_{31} – Registering returns and value corrections of commercial documents
p_{32} – Credit, invoice and payment collection problem solving
p_{33} – Claims and collecting products from customers
p_{34} – Stocktaking, stock control
p_{35} – Stock monitoring
p_{36} – Developing marketing programmes

p_{37} – Conducting market analysis for the needs of a customer
p_{38} – Presenting new products and technologies
p_{39} – Production problems solving
p_{40} – Meeting participation
p_{41} – Administrative work
p_{42} – Trainings participation
p_{43} – Supervision of completing the sales schedule
p_{44} – Quantity and quality claims servicing
p_{45} – Gathering data in a database on clients, potential clients, markets etc.
p_{46} – Delivery notification
p_{47} – Sales prognosis
p_{48} – Customers segmentation
p_{49} – Customer contact centres
p_{50} – Suppliers bidding
p_{51} – Settling up Sales representatives
p_{52} – Sales representatives' router planning
p_{53} – Planning types and elements of sales representatives' visits
p_{54} – Creating sales representatives' tasks
p_{55} – Reporting company's products and competitive products at customer's premises →
p_{56} – Creating sales plans for sales regions

m_n – Employee: m,n∈ N
Example: Employee in the sale area:
m_1 – Sales Director
m_2 – Sales Specialist
m_3 – Marketing Specialist
m_4 – Regional Assistant
m_5 – Product Manager

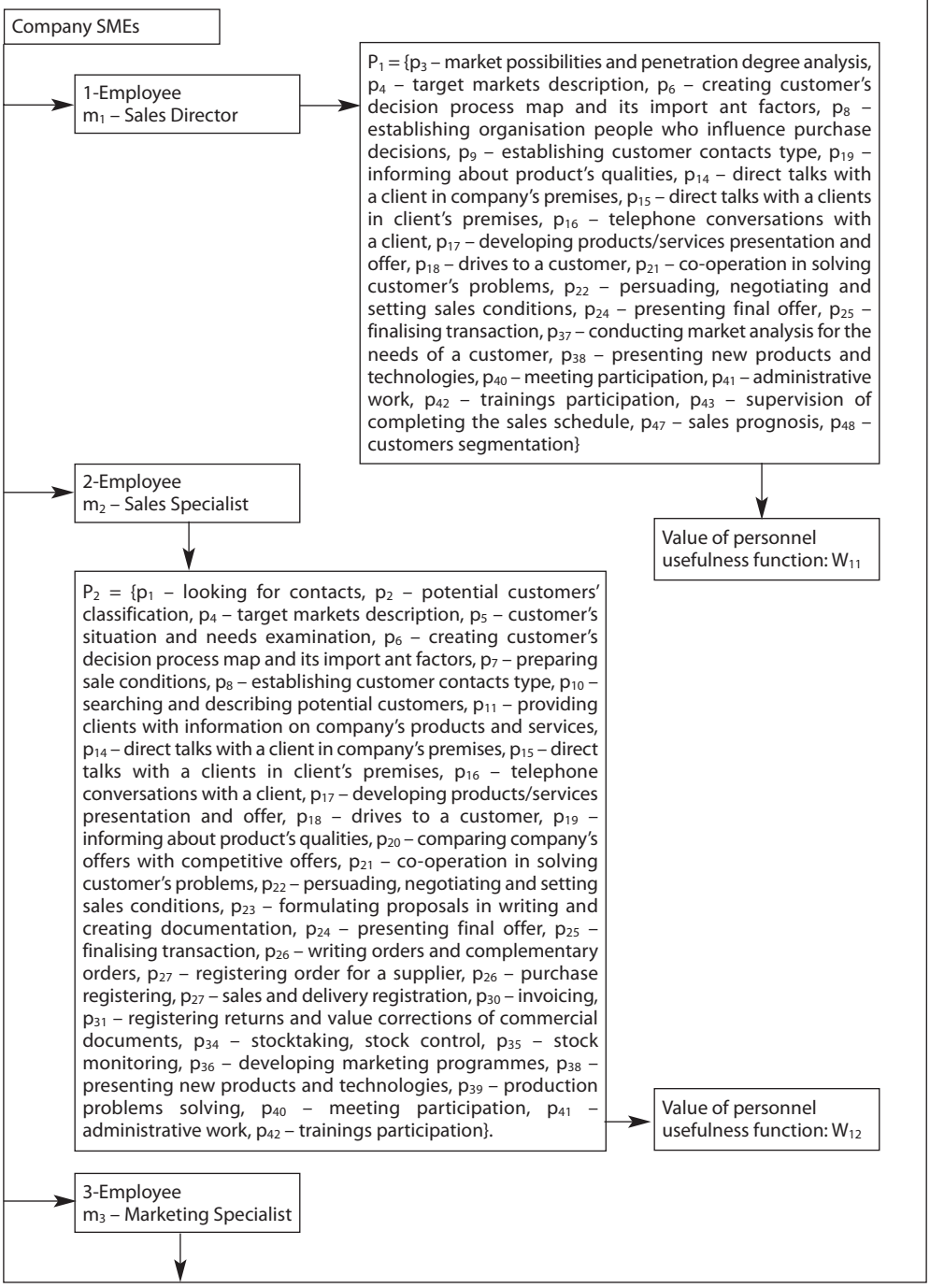
Source: own study.

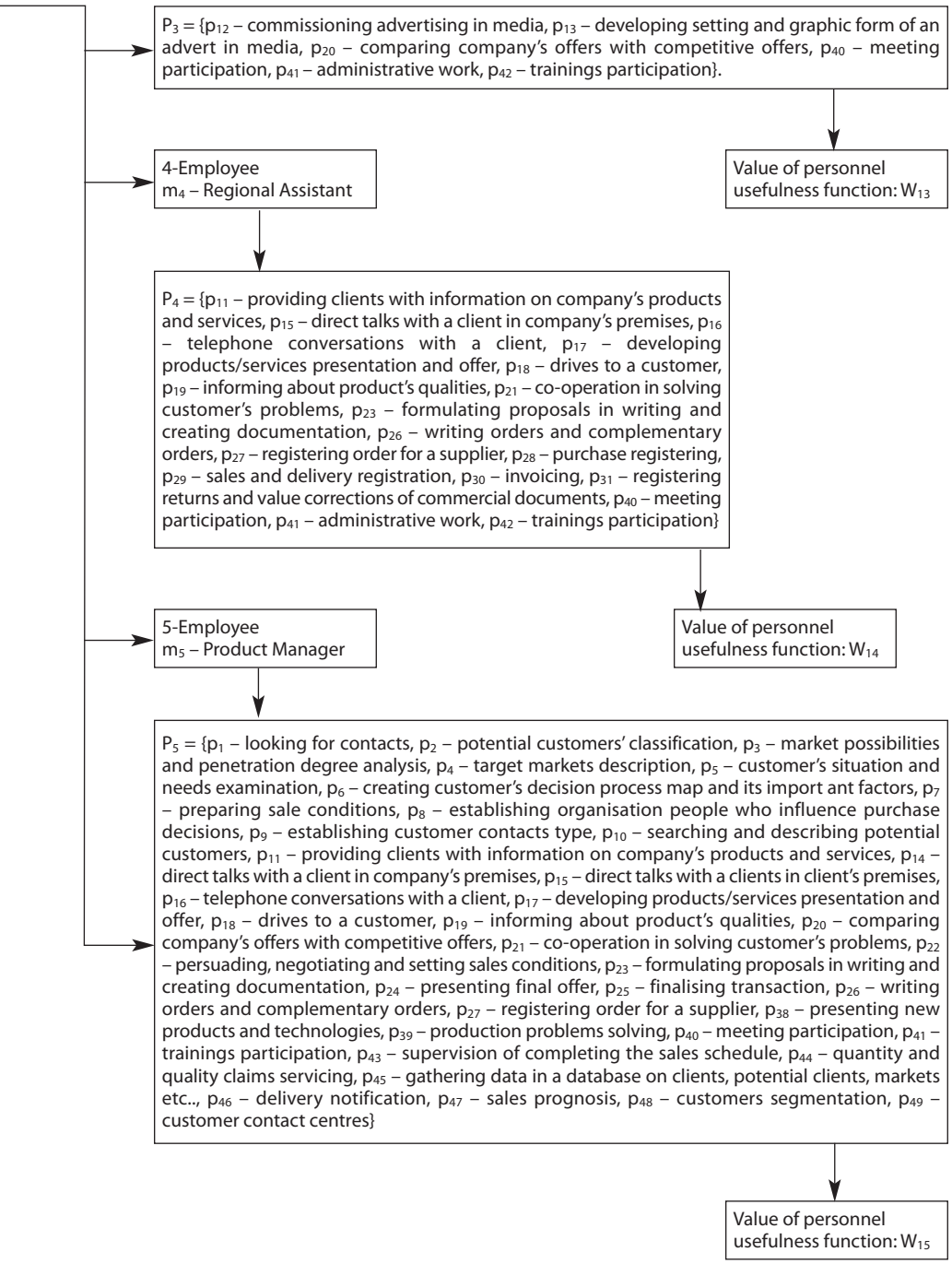
In this model SMEs the following conditions are formulated:

- SMEs consists n-functionality areas: $F_{n,}$ n∈ N.
- In the each area there are n-business processes: p_n, n∈ N.
- In the each n-th area work m-employees: m_n, n,m∈ N.
- Each employee in a functional area can participate in more than one business process.
- For each employee in the functionality area one can define a personnel usefulness function: W_{nm}, n,m∈ N.

Based on the research results the model of five employees in the sales functional area is shown in Figure 3:

Figure 3. A reference SME model: sales area example





Source: own study.

4. Indicator matrix to assess effectiveness and efficiency of investment in knowledge

4.1. The personnel SME usefulness function

So, let us define the personnel SME usefulness function W_{nm} for the m-th employee in the n-th functional area in the SME (Patalas-Maliszewska, 2009):
$W_{nm} = f(GK, PK, A, E, P, C, P)$, where $n, m \in N$ and:

- GK – General knowledge of the m-th employee. The value of this parameter is received as the result of tests for employee, which was evaluated within the range from 0 to 5, where 0 is a bad and 5 is a very good level of general knowledge.
- PK – Professional knowledge of the m-th employee. The value of this parameter is received as the result of tests for employee, which was evaluated within the range from 0 to 5, where 0 is a bad and 5 is a very good level of professional knowledge.
- A – Professional abilities of the m-th employee. The value of this parameter is received as the result of tests for employee, which was evaluated within the range from 0 to 5, where 0 is a bad and 5 is a very good level of professional abilities.
- E – Experience of the m-th employee. The value of this parameter is received as the result of tests for employee, which was evaluated within the range from 0 to 5, where 0 is a bad and 5 is a very goood level of experience.
- P – Patents of the m-th employee. The value of this parameter is received as the result of tests for employee, which was evaluated within the range from 0 to 5, where 0 is a bad and 5 is a very good level of patents.
- C – Clients of the m-th employee. The value of this parameter is received as the result of tests for employee, which was evaluated within the range from 0 to 5, where 0 is a bad and 5 is a very good level of clients.
- P – Personality of the m-th employee. The value of this parameter is received as the result of tests for employee, which was evaluated within the range from 0 to 5, where 0 is a bad and 5 is a very good level.

Effectiveness is measured by degree, it realizes system in that, it has been planned and its efficiency is defined by degree. This system uses the resources (Kosieradzka and Lis, 2000). So, the parameter like E, P and C are related to effectiveness, the parameter like GK, PK, A and P are related to efficiency.

So, the following personnel SME usefulness function W_{nm} for the m-th employee in the SME: is proposed:

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

where: $n, m \in N$.

The linear form of this function W_{nm} is chosen because all elements are independent and equally important to assess the effectiveness and efficiency of investment in knowledge (see point 3):

- $f_1(GK)$ – 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 $0 \le f_2(PK) \le 5$,
- $f_3(A)$ – the professional abilities function for the m-th employee in SME, where: $A \in R$, and $0 \le f_3(A) \le 5$,
- $f_4(E)$ – 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: $E = \frac{\sum_{i=1}^{3} di}{3}$ 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 $0 \le f_4(E) \le 5$,
- $f_5(P)$ – 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: $P = \frac{\sum_{i=1}^{4} ei}{4}$ 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 $0 \le f_5(P) \le 5$,
- $f_6(C)$ – 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: $C = \frac{\sum_{i=1}^{3} ki}{3}$ 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 $0 \le f_6(C) \le 5$,
- $f_7(P)$ – the m-th employee's personality in SME, where: $P \in R$, and $0 \le f_7(P) \le 5$.

It is possible to receive indispensable data for account of value personnel usefulness function from companies belonged to reference model of SME by interview in each enterprise. The next point of the article presents the values of personnel SME usefulness function W_{1m} for the m-employees and in the 1-th functional area (sale area) for the 10 companies.

4.2. Indicator matrix to assess knowledge in SMEs – case study

The indicator matrix is proposed based on literature and own scientific research. The matrix will help in assessing and forecasting knowledge in SMEs. The indicators include measures to show knowledge in SMEs. Indicators value create a base of parameters and indicators necessary to build a system supporting decision making at a strategic level as regards profitability of investing in knowledge.

The next step involves a survey in selected SMEs – has done by interview in 10 companies in line with the reference model. Based on the result research in the sale area in SMEs (the research group consisted of 10 companies, conformed to concentrate model

of enterprise – see Figure 3) the values of personnel usefulness function for the five employees (m = 5) in the sale functionality area (n = 1) in the each SMEs of 10 (matrix of personnel usefulness function) are created.

Table 1. Value of personnel usefulness function in the sale area in 10 companies: the matrix of personnel usefulness function for the five employees (m=5) in the sale functionality area (n=1) in 10 companies

SME	Workplace in the sale area	W_{1m}	% of max W_{1m}=35	f_1(Wo)	f_2(Wz)	f_3(Uz)	f_4(D)	f_5(Pt)	f_6(K)	f_7(O)
SME1	Sales Director	25	71%	1	5	5	4	0	5	5
SME1	Sales Specialist	4	12%	2	2	0	0	0	0	0
SME1	Marketing Specialist	12	34%	2	4	0	0	0	0	6
SME1	Regional assistant	13	37%	3	3	2	0	0	1	4
SME1	Product manager	16	46%	0	3	4	2	0	3	4
SME2	Sales Director	19	54%	2	4	2	2	0	4	5
SME2	Sales Specialist	13	37%	1	4	2	2	0	4	0
SME2	Marketing Specialist	18	51%	3	5	5	3	0	1	1
SME2	Regional assistant	19	54%	0	2	4	5	0	4	4
SME2	Product manager	18	51%	3	3	3	5	0	4	0
SME3	Sales Director	21	60%	2	3	5	2	0	4	5
SME3	Sales Specialist	15	43%	2	3	5	1	0	4	0
SME3	Marketing Specialist	12	34%	1	1	5	1	0	4	0
SME3	Regional assistant	12	34%	1	2	2	0	0	3	4
SME3	Product manager	20	57%	3	2	5	1	0	4	5
SME4	Sales Director	15	43%	0	4	5	1	0	4	1
SME4	Sales Specialist	12	34%	0	2	5	1	0	4	0
SME4	Marketing Specialist	14	40%	0	3	5	1	0	4	1
SME4	Regional assistant	17	49%	0	3	5	5	0	4	0
SME4	Product manager	16	46%	0	2	5	0	0	4	5
SME5	Sales Director	12	34%	0	2	5	0	0	4	1
SME5	Sales Specialist	17	49%	2	3	5	3	0	4	0
SME5	Marketing Specialist	13	37%	2	3	2	1	0	4	1
SME5	Regional assistant	15	43%	2	4	5	0	0	4	0
SME5	Product manager	17	49%	3	1	4	5	0	4	0
SME6	Sales Director	17	49%	1	2	5	4	0	5	0
SME6	Sales Specialist	9	26%	3	2	4	0	0	0	0
SME6	Marketing Specialist	12	34%	2	4	0	0	0	0	6

SME	Workplace in the sale area	W_{1m}	% of max W_{1m}=35	f_1(Wo)	f_2(Wz)	f_3(Uz)	f_4(D)	f_5(Pt)	f_6(K)	f_7(O)
SME6	Regional assistant	8	23%	2	3	2	0	0	1	0
SME6	Product manager	16	46%	0	3	4	2	0	3	4
SME7	Sales Director	21	60%	3	4	2	2	0	4	6
SME7	Sales Specialist	13	37%	1	4	2	2	0	4	0
SME7	Marketing Specialist	19	54%	3	2	5	4	0	1	4
SME8	Regional assistant	19	54%	3	2	4	2	0	4	4
SME8	Product manager	18	51%	3	3	3	5	0	4	0
SME8	Sales Director	21	60%	2	3	5	2	0	4	5
SME8	Sales Specialist	18	51%	0	3	5	1	0	4	5
SME8	Marketing Specialist	12	34%	1	1	5	1	0	4	0
SME8	Regional assistant	16	46%	3	4	2	0	0	3	4
SME8	Product manager	19	54%	3	2	5	1	0	4	4
SME9	Sales Director	15	43%	0	4	5	1	0	4	1
SME9	Sales Specialist	12	34%	0	2	5	1	0	4	0
SME9	Marketing Specialist	14	40%	0	3	5	1	0	4	1
SME9	Regional assistant	17	49%	0	3	5	5	0	4	0
SME9	Product manager	16	46%	0	2	5	0	0	4	5
SME10	Sales Director	23	66%	3	2	5	0	5	4	4
SME10	Sales Specialist	19	54%	2	4	5	3	0	4	1
SME10	Marketing Specialist	13	37%	2	3	2	1	0	4	1
SME10	Regional assistant	15	43%	2	4	5	0	0	4	0
SME10	Product manager	23	66%	3	1	4	5	0	4	6

Source: own study.

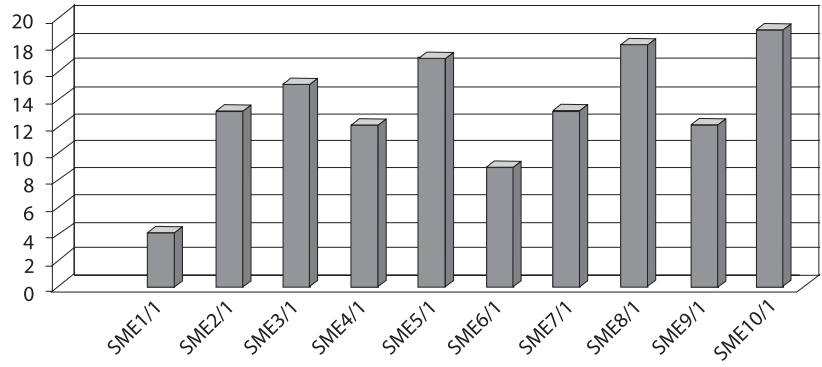
If we want to find out if the result is good for the given enterprises, we need to compare the received result to the value of "sales" department for each employee of another enterprise, according to the reference model. Next, we can consider if the present condition of intellectual capital is satisfactory.

Figure 4 presents example of the values of personnel usefulness function in the sale area in 10 companies for Sales Specialist based on the research results.

We can compare the value of personnel usefulness function in the sale area for sales specialist and the "best result" received the employee in SME10. Other companies can decide if the present condition of IC for sales specialist is satisfactory.

The value of personnel usefulness function may be used as complement of traditional valuation of a company, which is usually based on the value of tangible assets.

Figure 4. Values of personnel usefulness function for m_2 employee – Sales Specialist



Conclusions

Knowledge management includes four main functions, knowledge obtaining, knowledge refining, knowledge storing and knowledge sharing. This research discussed a new approach for assessing and forecasting the value of knowledge in SMEs.

When enterprises decide to increase their competitiveness, there is a need to improve their knowledge management capability first. The advantage of knowledge management allows the enterprise to achieve this goal.

The research is focused on a decision making model to asses the effectiveness of investment in knowledge in SMEs. The model includes synthetic measures for elements of the method (see Fig.1). Developing a decision making model is started with collecting information on the research subject. These are empirical data obtained through observation of SMEs operation. Model identification covers:

- determining the structure of the SMEs reference model for which the model will be applicable,
- determining indicators enabling to asses rationality and effectiveness of knowledge based on measurement of input and output data from SMEs studies,
- Determining data base of values of the characteristics of innovation – directions of further works,
- Using Group Method of Data Handling – directions of further works,
- Checking the quality of forcast value for selected indicators to assess rationality and effectiveness of investment in knowledge using the model.

In the research to follow it is planned to:

- Building of data base of values of the characteristics of innovation: I_i in SME for k-companies i,kÎN
- Building of model bases on collected data to asses and the forecast of knowledge (using the GMDH method).
- Building an IT tool for supporting decision making at strategic level as regards profitability of investment in employees' qualifications and skills based on collected data.

- Verification of research experiment.

The SknowInnov method, which has been introduced in this paper, gives more possibilities in the area of knowledge profitabilities. This approach seems to be, apart from a common calculation of the investment profitabilities, an excellent tool for knowledge economical analysis. The suggested IT tool for supporting decision making at strategic level as regards profitability of investment in employees' qualifications and skills based on collected data will connect the selected factors of SME effectiveness with the characteristics of innovation and the indicators enabling to asses rationality and effectiveness of knowledge. In consequence this method allows for the knowledge evaluation.

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Metoda oceny i prognozowania wartości wiedzy w przedsiębiorstwach sektora MSP – wyniki badań

Streszczenie

Decyzje o inwestowaniu w wiedzę w przedsiębiorstwach podejmowane są zawsze na poziomie strategicznym organizacji (Haas-Edersheim, 2007). W teorii zarządzania oraz w praktyce gospodarczej wyróżniono liczne metody jakościowe analizy kapitału intelektualnego oraz metody wyceny wartości kapitału intelektualnego (Mikuła, 2002; Edvinsson, Malone, 2001; Kasiewicz, Rogowski, Kicińska, 2006; Szczepankowski, 2006). Jednak wiele zgłaszanych koncepcji pomiaru niematerialnych aktywów przedsiębiorstwa nie doprowadziło do sformułowania jednoznacznej metody oceny wartości kapitału intelektualnego w przedsiębiorstwach.

W artykule zaprezentowano autorską metodę oceny i prognozowania wartości kapitału intelektualnego w przedsiębiorstwie sektora MSP. Metoda ta opiera się na czterech integralnych jej częściach: model referencyjny przedsiębiorstwa sektora MSP, macierz oceny inwestowana w wiedzę, wskaźniki innowacji, algorytm GMDH. Metoda została opracowana na podstawie literatury przedmiotu oraz w oparciu o badania empiryczne przeprowadzone w przedsiębiorstwach sektora MSP.