Model of innovation transfer in small and medium enterprises (SME)

Justyna Patalas-Maliszewska[1]/University of Vienna/Austria, University of Zielona Góra, Polen

Irene Krebs/ Brandenburg University of Technology Cottbus/Germany

Summary: Innovation transfer has already become the priority for the science society, governments and entrepreneurs. In this paper the concept of innovation transfer in SME based on defined indicators value is described. The analysis of innovation transfer tools based on the experience of the Lubuskie region (Poland) and the Brandenburg region (Germany) is discussed. Consequently the model of innovation transfer - based on correlations between innovation level in the enterprise sector SME and with relevant indicators in the surrounding area – is presented in this paper.

1. INTRODUCTION

Innovation is key to progress, development, and sound governance and public administration. Innovation is also key to invention and re-invention in all spheres of life, society, science, technology, and administration. Innovation is also connected with the knowledge and technology transfer to an enterprise. The competitive advantage depends actually on adjusting knowledge to company structures. Entrepreneurs as well as science and research people believe that there is a shortage of knowledge transfer mechanisms for innovation, innovation awareness, culture and education. Research will contribute to increased possibilities for development and improvement of competitiveness of companies by extending the base supporting development of research, innovation, and technologies. The one of the most important indicators of competitive advantage in SMEs is innovation transfer [Patalas J., Mutwil J., 2006].

In the case of innovation transfer to small and medium enterprises, anticipative capacity building is key to prepare and develop competitive advantage in SMEs. Innovation is also key to learning organizations with learning leadership capacity that must lead and manage those organizations for high performance and productivity [Schein, 1995], [Argyris Ch., 1996].

The researching problem has been formulated: there is a small and medium-sized enterprise which defined business processes in each functionality area. Are there examples of cooperation science with industry based on the support of available organizational instruments

---

in the Lubuskie region (Poland) and the Brandenburg region (Germany). Is there any model of innovation transfer in small and medium enterprises (SME)"?

In this paper the concept of innovation transfer model in SME based on defined indicators value is described. The analysis of innovation transfer tools based on the experience of the Lubuskie region (Poland) and the Brandenburg region (Germany) is discussed. Consequently the model of innovation transfer - based on innovation level in the enterprise sector SME is presented in this paper.

2. EXPERIENCES FROM COOPERATION WITH INDUSTRY OF THE LUBUSKIE REGION (POLAND) AND THE BRANDENBURG REGION (GERMANY)

In the Lubuskie region (Poland) and the Brandenburg region (Germany) are created the well-organised structures with clear communication networks and tools as well as to involve main innovation players of the such bodies:

- Governmental Agency for Enterprise Development

The purpose Agency activity is to support entrepreneurship through implementation of actions aimed at using innovative solutions by entrepreneurs, development of human resources, expansion on international markets, regional development. The central self administration of the science in order to support research at colleges and publicly financed research institutions.
  - Deutsche Forschungsgemeinschafft DFG (www.dfg.de)
  - Polish Agency for Enterprise Development (www.parp.gov.pl)

- Technology Transfer Centre

The Centre does not aim at profits, it is an advisory and informative unit. The Centre supports and assists with the implementation of technology transfer and offers: information 47%, advise 10%, training 41%, other 2%. It is something like „Bridging the Gap Between University and Industry". The mission is growth paths of technology-based companies by innovations.Services, offered by the technology transfer place: care of F&E – cooperation with small and middle class businesses, care of protection and utilization of invention (patents advisory board), support of business start-up from college, builduing the technology network
  - Center for Enterprise and Technology Transfer of University of Zielona Góra (www.cptt.uz.zgora.pl)
  - BTUTech Technologietransferstelle an der BTU Cottbus
    (www.tu-cottbus.de/technologietransfer)

- Personnel transfer

A special form of technology transfer is the personnel transfer of trainees and graduates
  - Career Center, Jobboerse BTU Cottbus

- Science and Technology Park

A place where the science and business environments meet. It is a multidisciplinary centre gathering specialists of the sciences, natural sciences and technologies. Through functional buildings the Park can create optimal conditions for running businesses offering a wide variety of business orientated services.

- ▪ Science and Technology Park of University of Zielona Góra (www.pnt.uz.zgora.pl)

The regions should play an important role in creating an environment conducive to innovation, which helps the SMEs, to become more innovative and technology-oriented.

Insufficient internal ability of SMEs for innovation creation incline for looking for knowledge-, finance- and technical resource in the surrounding area. The competitive advantage depends on the development of adjusted resource in the SMEs. Innovative SMEs should own system of management according to principles of systematic innovations organized, requiring follow all available source innovation [Drucker P.F.,1992].

It is defined the following external factors forming innovative enterprises (SMEs):

- global technical development,
- global development of new product,
- innovative policy
- development of modern adminstrations [Krebs, I., Patalas-Mailszewska, J. 2009](Fig. 1).

And internal factors forming innovative enterprises (SMEs):

- personality of management unit ,
- experience of management unit,
- human resource,
- relations with clients,
- cooperation with research and Development institution
- localization of SMEs
- profit of SMEs (Fig.1).

```
┌─────────────────────────┐      ┌──────────────┐      ┌─────────────────────────┐
│ External factors forming│      │              │      │ Internal      factors   │
│ innovative enterprises: │  ⟩⟩  │  Innovative  │  ⟨⟨  │ forming      innovative │
│                         │      │              │      │ enterprises:            │
│   • economical          │      │     SMEs     │      │                         │
│     enclosing,          │      │              │      │   • human-,             │
│   • social enclosing,   │      │              │      │     finance- and        │
│   • international       │      │              │      │     technical           │
│     enclosing,          │      │              │      │     resource            │
│   • low enclosing,      │      │              │      │   • client              │
│   • technical           │      │              │      │   • competition.        │
│     enclosing.          │      └──────────────┘      │                         │
│                         │                            └─────────────────────────┘
└─────────────────────────┘
```
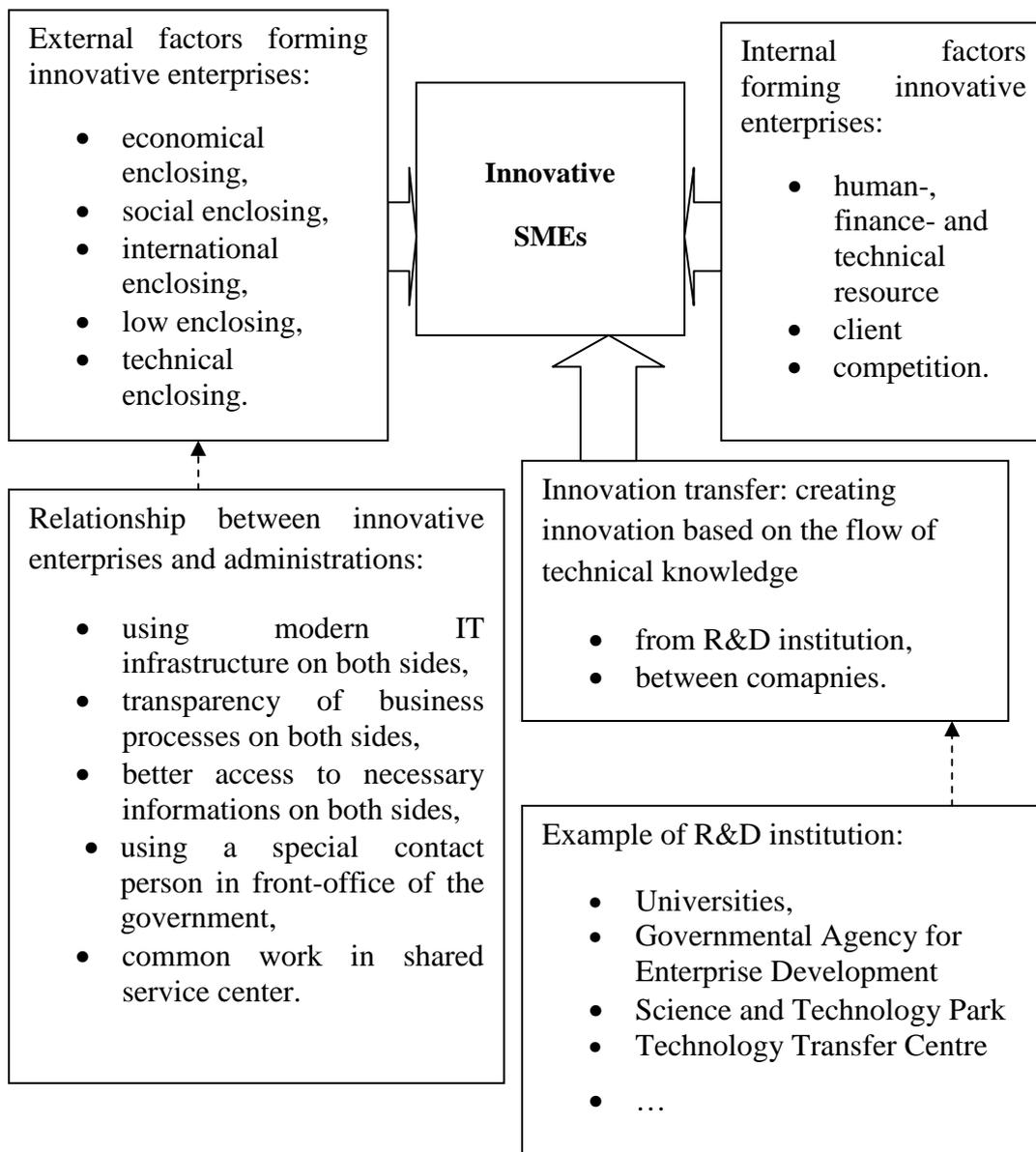
Fig. 1. Factors forming innovative enterprises (SMEs)

Based on the research results [Innovation tomorrow. Innovation Policy study, 2002] it is defined, that task of innovative policy should be to determinate the method of analysis innovation and to take a decision in range of region innovative. The innovative should be the main power of each creative organization, on steadily in its system of management inscribed [Pomykalski A., 2001].

3. MODEL OF INNOVATION TRANSFER IN SME

Small and medium enterprises in an especially flexible way adjust to the market requirements and clients' needs by changing activity's profile, products (services) assortment and by forming work time and activities' forms. The connection of resources of many co-operating enterprises makes it possible to concentrate on key skills (competences) of the company.

The main problem that involves decision making process about innovation transfer in SMEs, which is understood as a problem to such an innovations selection that would guarantee the improvement of the competitive advantage of company.
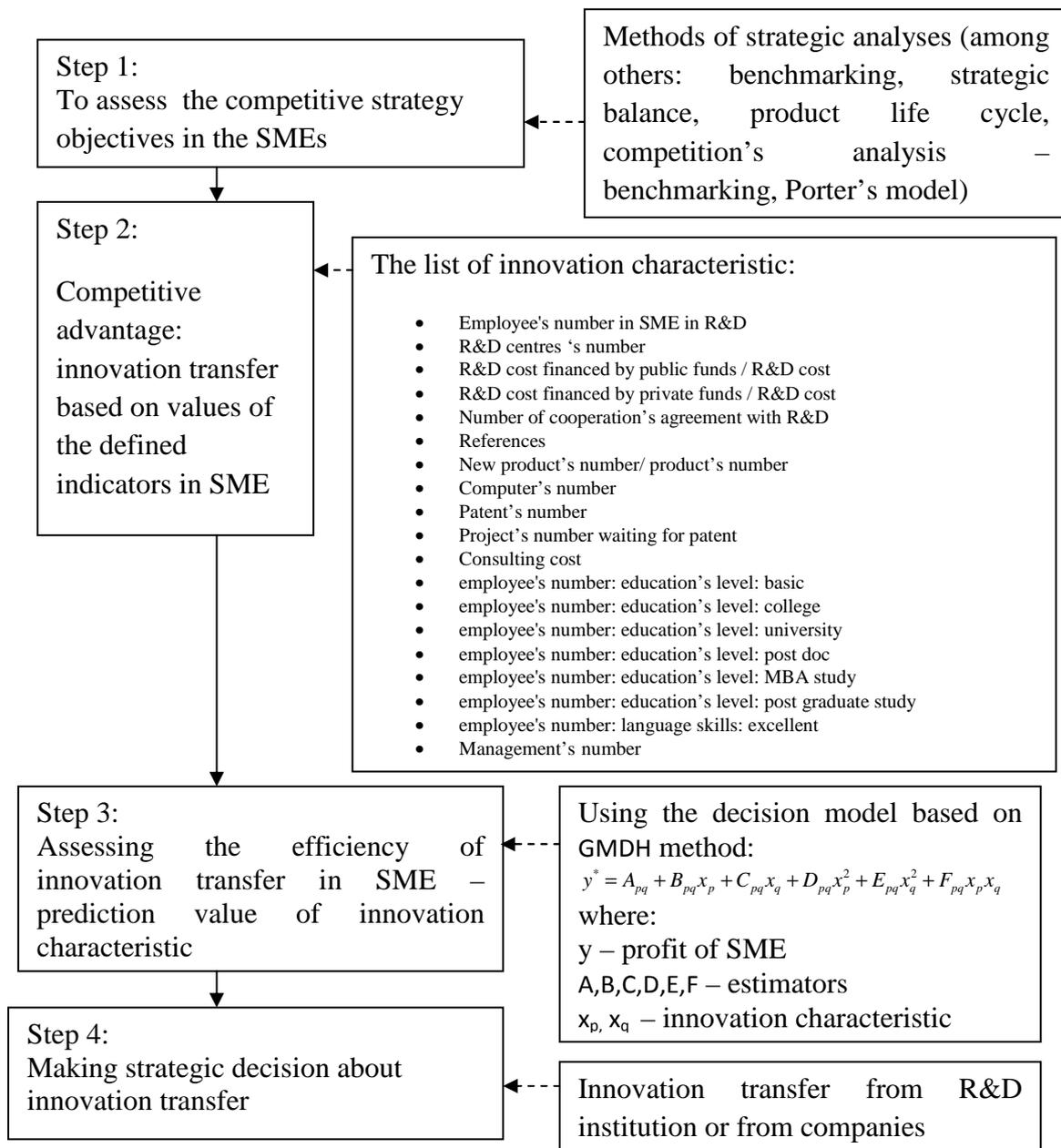
Step 1:
To assess the competitive strategy objectives in the SMEs

Methods of strategic analyses (among others: benchmarking, strategic balance, product life cycle, competition's analysis – benchmarking, Porter's model)

Step 2:

Competitive advantage: innovation transfer based on values of the defined indicators in SME

The list of innovation characteristic:

- Employee's number in SME in R&D
- R&D centres 's number
- R&D cost financed by public funds / R&D cost
- R&D cost financed by private funds / R&D cost
- Number of cooperation's agreement with R&D
- References
- New product's number/ product's number
- Computer's number
- Patent's number
- Project's number waiting for patent
- Consulting cost
- employee's number: education's level: basic
- employee's number: education's level: college
- employee's number: education's level: university
- employee's number: education's level: post doc
- employee's number: education's level: MBA study
- employee's number: education's level: post graduate study
- employee's number: language skills: excellent
- Management's number

Step 3:
Assessing the efficiency of innovation transfer in SME – prediction value of innovation characteristic

Using the decision model based on GMDH method:
$$y^* = A_{pq} + B_{pq}x_p + C_{pq}x_q + D_{pq}x_p^2 + E_{pq}x_q^2 + F_{pq}x_p x_q$$
where:
y – profit of SME
A,B,C,D,E,F – estimators
x_p, x_q – innovation characteristic

Step 4:
Making strategic decision about innovation transfer

Innovation transfer from R&D institution or from companies

Fig. 2 Model of innovation transfer in SME

3.1 Case study

In order to illustrate the model of innovation transfer (Fig. 2) let us consider the SME that is about to make decision concerning the innovation transfer and that belong to the reference model [Patalas-Maliszewska J., Werthner H., 2010]. The reference model has been developed (an SME according to the regulation dated November 12, 1999, Commercial Law – Dz .U .Nr 101, poz 1178), which includes the following: the legal aspect of SME operation, SME business areas, the basic and supporting activity areas description, work-places description.

The main problem in responding to the question whether a given innovation will guarantee us obtaining the assumed level of an SME performance index for the assumed costs and existing limitations or not is presented as a decision problem. In order to illustrate the possibility of answering the question, let us analyze whether there exists an innovation that would allow an SME to reach the intended objectives assessed using arbitrarily chosen SME innovation characteristic.

SMEs is made decision about innovation transfer (step 1, Fig. 2). It was defined the values of innovations characteristic in SME (step 2, Fig. 2):
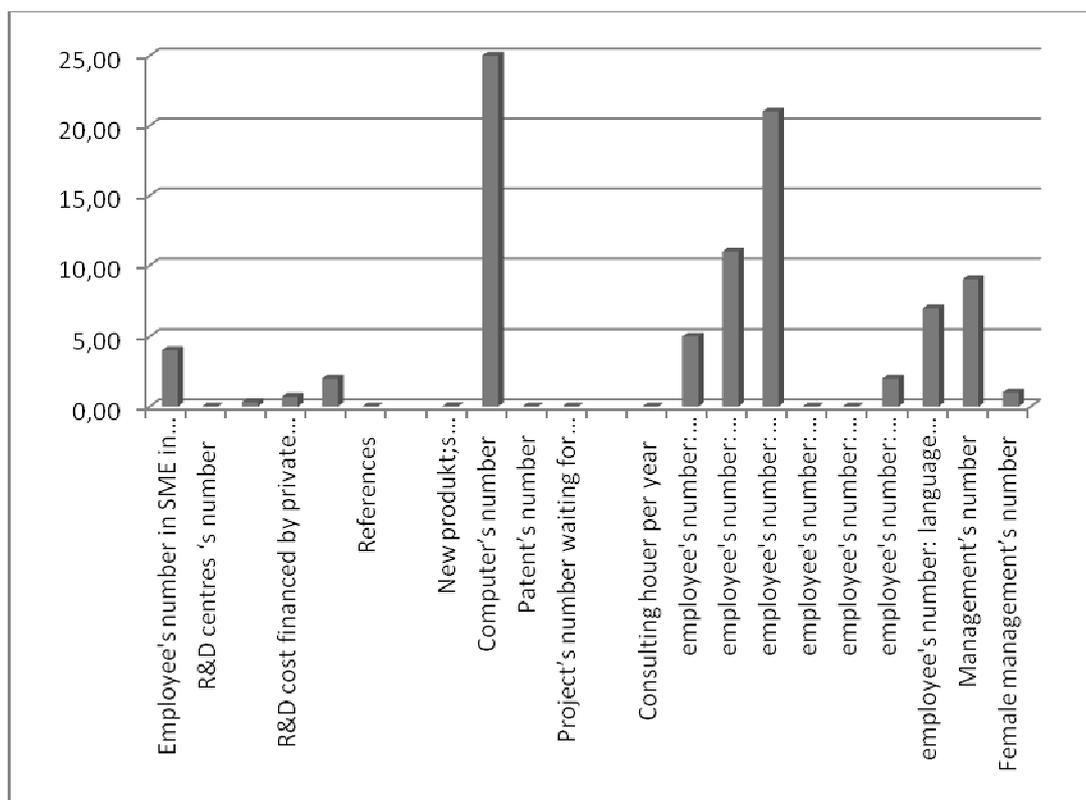

Fig. 3 The values of innovation characteristic in SMEs

In accordance with the values of the selected innovation parameters (see Tab. 1), there was constructed a decision model which contains the method of GMDH which bounds the selected innovation characteristic (step 3, Fig. 2).

Tab. 1 Values of innovations characteristic

SME	y - Profit in SME	x1 - Employee's number in SME in R&D	x2 - R&D centres's number	x3 - R&D cost financed by public funds (in PLN)/Research and development cost	x4 - R&D cost financed by private funds (in PLN)//Research and development cost	x5 - Number of cooperation's agreement with R&D company	x6 - References	x7 - New produkt;s number/product's number	x8 - Computer's number	x9 - Patent's number	x10 - Project's number waiting for patent	x11 - Consulting houer per year	x12 - employee's number: education's level: basic	x13 - employee's number: education's level: college	x14 - employee's number: education's level: university	x15 - employee's number: education's level: post doc	x16 - employee's number: education's level: MBA study	x17 - employee's number: education's level: post graduate study	x18 - employee's number: language skills: excellent	x19 - Management's number	x20 - Female management's number
2007	733 (thousand, in PLN)	4	0	0,3	0,7	2	0	0,01	25	0	0	0	5	11	21	0	0	2	7	9	1
2008	820 (thousand, in PLN)	6	0	0,4	0,6	4	2	0,01	30	0	0	0	5	10	29	0	0	4	10	10	1

So, using the GMDH method (see Step 3, Fig. 2) we have received the decision model:

$y = -4{,}25x_1 + 8{,}69x_4 - 0{,}008\,x_1^2 + 0{,}007x_4^2 - 0{,}005\,x_1\,x_4$, where

x_1 - employee's number in SME in R&D

x_2 - R&D cost financed by private funds (in PLN)//Research and development cost

This model enables us to carry out an assessment of the profitability value indicator connected with innovation in the SME that is about to make decision concerning the innovation transfer and that belong to the reference model. This model is a synthetic indicator of effectiveness that consist of certain particle indicators: employee's number in SME in R&D and R&D cost financed by private funds (in PLN)//Research and development cost.

The selected criteria of innovation transfer efficiency enable us to proceed monitoring of a group of companies that are similar in relation to the user`s demands and also gives way to the development of innovation transfer processes which would meet the required demands.

On the basis of an analysis of the literature on the subject, and through observing economic reality, the following concept of the model of innovation transfer in SME have been defined (see Fig. 2) [Furman J.L. et al. , 2002], [Romjin and Albaladejo, 2000], [INSEAD , 2007],. The decision about the innovation transfer or implementation requires the company management to assess the efficiency of this investment. The decision model based on GMDH method makes it possible to obtain a forecast of the value of the profit of SME depended on the innovation characteristic. GMDH is an modeling algorithm based on processing empirical data. This algorithm is chosen, because enabling us to define the most important influence the measurement of the value of the innovation characteristic and of the value of profit of SME.

On the basis of data found in the base of the values of profit of SME and innovation characteristic in SME from 2007 and 2008 (see Table 1) the variants of the GMDH algorithm which are available in a computer program were examined. The task of the algorithm was to define 'the best' polynomial with the lowest value of the criterion of regularity for the subject (a company of the SME sector). The process of the algorithm evaluation finished on the second iteration (a second degree polynomial). In this way, *'the best' polynomial* was chosen to be in the diagram, and it was this which had the smallest error of modelling.

The models allow us to define the value of the profit in SME depended on the innovation characteristic. On the basis of the forecasted values of these indicators, the company's board of directors will make a decision about the innovation transfer.

The model of innovation transfer in SME (see Fig. 2) is usefully for SME, they would make the decision about the innovation transfer or implementation. Using the GMDH method gives us the possibilities, on the basis of data of the values of profit of SME and innovation characteristic in SME from past years for each SME, to define the prediction value of profit of SME depended on the innovation transfer.

It means that, for some companies, the assessment of the effects which innovation transfer would bring can be done on the basis of previously defined criteria of the experience of those companies which have already applied innovation.

4. CONLUDING REMARKS

To be competitive, the SMEs should find the support in the innovative police in region in order to gain knowledge and innovation as a "driving force of the growth" (in accordance with the document, "Common Actions for Economic Growth and Employment – the New Beginning of Lisbon Strategy"). It is necessary to be a more attractive business partner than other enterprises by means of patents, technology, location and products quality. And it is also necessary for innovative enterprises to have relationship to modern administrations.

The model, which has been introduced in this paper (see Fig. 2) gives more possibilities in the area of profitability of the innovations transfer. The research which is in progress is focused on the development of the SME knowledge database which would be similar in terms of functionality fields as well as defined user's needs.

REFERENCES

- Argyris Ch. and Schon D. Organizational Learning II. New York: Addison-Wesley Publishing Co., 1996
- Commercial Law – Dz .U .Nr 101, poz 1178, November 12, 1999,
- Drucker P.F., „Management of XXI", Muza, Warszawa 2000, (in polish)
- Furman J.L., Porter M.E., Stern S.: "The determinants of national innovative capacity", Research Policy, Volume: 31, 2002, pp. 899—933
- Innovation tomorrow. Innovation Policy study, 2002

- INSEAD , Global Innovation Index: More on Methodology, 2007, INSEAD Global Innovation Index
- Krebs, I.; Patalas-Mailszewska, J. 2009, An E-Administration Strategy for Innovation Transfer, in: "5th International Vilnius Conference. Knowledge-Based Technologies and OR Methodologies for Strategic Decisions of Sustainable Development", Grasserbauer, M.; Sakalauskas, L.; Zavadskas, E. K. (Eds.), Publisher: VGTU Press "Technika", Vilnius, ISBN 978-9955-28-482-6, S. 381-385, 2009.
- Patalas J., Mutwil J.: "The koncept of measure of intelectual capital", Metody i techniki zarządzania w inżynierii produkcji / red. J. Matuszek Bielsko-Biała: Wydaw. Akademii Techniczno-Humanistycznej, 2006 (in polish)
- Patalas-Maliszewska J., Werthner H., "The method for assessing and forecasting value of knowledge in SMEs – research results", Wien, 2010
- Pomykalski A., Innovation management, PWN, Warszawa–Łódź 2001, (in polish)
- Romjin H., Albaladejo M.: "Determinants of innovation capability in small UK firms: an empirical analysis", Working Paper No: . 40, University of Oxford, Queen Elizabeth House, 2000
- Schein E., Organizational Culture and Leadership. San Francisco: Jossey-Bass., 1995
- www.dfg.de
- www.parp.gov.pl
- www.cptt.uz.zgora.pl
- www.tu-cottbus.de/technologietransfer
- www.pnt.uz.zgora.pl