INNOVATION ACTIVITY OF COMPANIES: THEORETICAL AND PRACTICAL ISSUES

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Abstract

The article contains an analysis and evaluation of selected issues of innovation activity of companies in economic theory and practice. Due to progressing processes of globalization, companies are forced to seek for such fields of business activity that enable growth of competitiveness. One of such areas is the innovation-based business that is stimulated by EU funds as part of innovation projects and programs.

Key words: innovation in companies, model optimization, EU projects

INTRODUCTION

Innovation business activity of companies constitutes a dominating area of development strategy of every company. This fact is connected with multiple various premises. The basic meaning of innovation is the result of mostly progressing economic globalization, as well as dynamically developing competitiveness of companies. The continuously shortening time of goods deliveries from the furthest locations on earth, forces the companies to take up challenges and respond rapidly to market demands. The response of companies is performed in different forms and scopes. At its root there are coordinated innovation activities of particular countries or international organizations. A particular importance of such processes can be observed within the European Union, which implements multiple different programs. The beneficiaries of such innovation activities have been touched upon. The strategic meaning of innovation in EU has been stressed by, among others, appointing of the European Institute of Innovation and Technology (EIT) in 2005, which concentrates on the concept of public-private cross-border partnerships – Knowledge and Innovations Communities (KIC). As a result of cooperation of scientists, entrepreneurs and managers, there are established innovation-based companies, new technologies and innovation projects for industry. Among the most important ones are:

- Climate KJC – against climate change. Partnership unit are located in London, Zurich, Berlin, Paris and Randstad. Six regional implementation centers are located in other countries.
- KJC InnoEnergy has been established for the purpose of commercialization of new solutions in the scope of production and distribution of balanced energy. The partnership units are located in Karlsruhe, Grenoble, Eindhoven/Leuren, Barcelona, Stockholm and Krakow.
- EJT JCT Labs – concerned with commercialization of opportunities coming from development of information-communication society. Partnering subjects are located in the following cities: Berlin, Eindhoven, Helsinki, Paris and Stockholm. [13]

In modern approach to the meaning of region in EU, it is crucial to expose its creative character within the scope of innovation and knowledge incubator. If we assume that innovation consists of territory-oriented processes, we need to point to basic problems and determining factors crucial for their execution. Among them are [7]:

BASIC DETERMINANTS OF INNOVATION ACTIVITIES IN COMPANIES

The functioning of companies in conditions of global economy, with growing competitiveness requires searching for new spheres of development and establishing cooperation with other subjects. Currently the innovation processes are becoming the subject of such diverse activity. Every companies, aiming at development, and after performing an analysis of possibilities and risks, concludes that it owns a certain capital, which should enable implementation of innovation.

Intellectual capital is of crucial importance in company innovation processes. It constitutes a basis for knowledge transfer and creation of value chain. The economy demands, especially the demand for company innovation, inspire scientific research which effects are verified by experiments. There is also compiled documentation for the purpose of implementation of product and process-oriented innovation.

The potential of intellectual capital may be used on microeconomic and macroeconomic scale. On macroeconomic scale, the conditions of application of intellectual capital within the scope of innovation are made up by European Union, using multiple different programs. Given the large scope of issues, only selected EU problems of programs and projects within the scope of innovation activities have been touched upon. The strategic meaning of innovation in EU has been stressed by, among others, appointing of the European Institute of Innovation and Technology (EIT) in 2005, which concentrates on the concept of public-private cross-border partnerships – Knowledge and Innovations Communities (KIC). As a result of cooperation of scientists, entrepreneurs and managers, there are established innovation-based companies, new technologies and innovation projects for industry. Among the most important ones are:

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• establishing of network relations, enabling the creation of innovation environment.

• spatial location in gathering knowledge and innovation resources. Concentration of assets of a company from a given region on such activities creates synergy mechanisms enabling achievement of better results, rather than in case of particular business entity's individual activities.

• application of resources unique for a given region, in the process of absorption and diffusion of innovation. The innovation potential of companies is mostly determined by the specifics of regional resources. Among them we can distinguish skilled employees and local resourcefulness.

• cultural-social determining factors of innovation, displaying the canons of value procedures and exchange of knowledge, creating a unique form of relational capital.

In such activities it is also crucial to refer to knowledge. Concepts based on knowledge are considered the source of innovation. Application of such resources leads to drawing up new working methods, and, in consequence, implementing modern technologies (e.g. the Internet, global positioning system). [9]

Special importance of knowledge management in innovation process is given to science and technology processes. Changes in economy processes in Central and Eastern European countries, led to dynamic interest of entrepreneurs in various innovation centers. Science and technology parks have become one of the most important places of this sort, using multiple various EU structural funds. An important function of science and technology park is mediation in the transfer of innovation and creation of market of research and development services. [2]

Compared to the above mentioned determinants, it is possible to refer to the directions leading to enhancement of innovation in Polish economy (Table 1). The given directions show that the aim of economic activities in years 2007-2013 in Poland, as well as other Central and Eastern European countries, was transformation of social awareness to the idea that innovation activities are the most important development opportunity for these countries. It would serve as a foundation for creation of competitive economy on local, regional and international markets.

Marhematical Model In Coordination Relations Of Company Departments With Respect To Innovation

Business activity of a company requires systematically performed analysis of development strategies. The level, scope and time of analysis is determined to a great extent by availability of data. It is then necessary to determine tasks in the area of data gathering, for each of the production departments, staff or board members. On multiple occasions such data is gathered by different departments, however, their application should be of integrated nature. For instance, the marketing, logistics and production departments, for strategic reasons, should synchronize the times of goods delivery to their clients with flow of material goods in the stage of their purchase. [6]

Strategic decisions require possession of all available data, while utilizing mathematical methods and model. In mathematical models we take given decision variables, restricting conditions and strategic aim of manufacturing company. We can point at multiple exemplary solutions of mathematical models, describing the decisive processes in manufacturing companies, in the strategic aspect. For the point of departure we took the tasks performed by all departments in a manufacturing company. Therefore, we assume that each department constitutes one of the links in a company, co-accomplishing a strategic aim of a given economic subject. These departments are marked d1,d2,...,dn. Simultaneously, we take the assessment criteria of particular departments from the point of view of strategic goals accomplishment of the whole company. These criteria are marked as l1,l2,...,ln.

Therefore, D = (d1,d2,...,dn) constitutes a set of departments (organizational entities) of a manufacturing company. The set of criteria is put down in the following way: L = {l1,l2,...,ln}.

Mutual relations between departments of a manufacturing company have been put down in functional dependency in the following way:

\[ f: D \times L \rightarrow Q \left( R^+ \cup \{0\} \right) \] (1)

such that

\[ f \left( p_{ij} \right) = q_{ij} \in R^+ \cup \{0\} \] (2)

where

\[ p_{ij} = (d_i,l_j) \] (3)

for

\[ i \in A = \{1,2,...,m\}, j \in B = \{1,2,...,m\} \]

that is

\[ (i,j) \in A \times B \]

R set of f function value on Cartesian product D x L may be put down in the form of matrix:

\[ Q = \begin{pmatrix}
q_{11} & \cdots & q_{1n} \\
\vdots & \ddots & \vdots \\
q_{m1} & \cdots & q_{nm}
\end{pmatrix} \]
which contains non-negative number pairs measure
\[ P_{ij} = (d_i, l_j) \in D \times L \] (4)

Especially \( Q_{ij} \) is a measure of \( P_{ij} \), so we may assume that \( Q_{ij} = |P_{ij}| \) and even symbolically \( Q = |P| \), where matrix:

\[ P_{11} \ldots P_{1m} \\
... \ldots \ldots \\
P_{nt} \ldots P_{nm} \]
or set

\[ P = \{ P_{11}, \ldots, P_{1m}, P_{nt}, \ldots, P_{nm} \} \] (5)

The above notations point to system dependencies of particular departments of a company. The effects of work of each department are the result of the effort of a given department, but their level is also influenced by the results of activities of the remaining departments. We may, therefore, consider functional dependencies in the scope of production, marketing or logistics. Generalizing the functional dependencies we take the \( g \) function of innovation business activities:

\[ P \rightarrow W \in R^+ \cup \{0\} \] (6)
such that

\[ w_{ij} = g(P_{ij}) \geq 0 \quad \text{and} \quad \sum_{i=1}^{n} \sum_{j=1}^{m} w_{ij} = 1 \quad \text{for} \quad (i,j) \in A \times B \]

\[ w_i = \sum_{j=1}^{m} w_{ij} > 0 \quad \text{for} \quad i \in A \quad \text{and} \]

\[ w_j = \sum_{i=1}^{n} w_{ij} > 0 \quad \text{for} \quad j \in B \]

The number \( W_{ij} \in W \) denote parameters of action of particular departments of a company in the aspect of innovation. Particularly the number \( W_{ij} \) for \( (i,j) \in A \times B \) is a parameter of pair \( P_{ij} = (d_i, l_j) \in D \times L \).

The inserted innovation parameters are covered by the matrix:

\[ W = \begin{array}{cccc}
W_{11} & \ldots & W_{1m} \\
\vdots & \ddots & \vdots \\
W_{nt} & \ldots & W_{nm}
\end{array} \]

Number \( Z_{ij} = W_{ij} \times Q_{ij} \) for \( (i,j) \in A \times B \) will be called a preferential (optimizing) parameter of pair of \( P_{ij} \) departments, that is the preference of the \( di \) company’s department regarding \( lj \) criterion in the aspect of innovation business activities.

Matrix:

\[ Z = \begin{array}{cccc}
Z_{11} & \ldots & Z_{1m} \\
\vdots & \ddots & \vdots \\
Z_{nt} & \ldots & Z_{nm}
\end{array} \]

Consisting of preferential pairs, it shows preferential \( D \) sets of company departments and \( L \) sets of their assessment criteria, including the \( W \) set, that is the taken parameters.\(^1\) [10]

The aim of the presented model is exposing innovation activities of a company, especially coordination of work of various organizational entities for innovation optimization. Mathematical models and their computer applications have been pointed out by W. Steingartner, D. Radakovic and M. Benckova.[1, 12]. Adapting of the models enables decisive processes, especially with great amount of variables and turbulent environment.

**ANALYSIS OF INNOVATION BUSINESS ACTIVITIES, BASED ON SURVEY RESULTS.**

The presented determinants of innovation activities and model solutions require verification in practice of company functioning. Every company, within the scope of its worked out strategy, takes various actions in the area of innovation, aiming at improvement of competitive position. The innovation potential of companies is, however, considerably diverse, especially in relation to their size or business structure. The above criteria of company division mark the foundation for surveys in the area of innovation. For the purposes of the present paper, there have been presented selected survey results as part of EU projects. As part of one of the projects, surveys were sent to 307 companies. 45% of small businesses, 30% of medium businesses and 25% of micro-businesses took part in the survey. These businesses were put in the following groups, according to PCA (Polish Classification of Activity):

- manufacturing of medical, precision and optical instruments, and clocks – 36%,
- manufacturing of machines and devices – 27%,
- manufacturing of machines and electrical equipment – 16%,
- manufacturing of motor vehicles, trailers and semitrailers – 4%,
- manufacturing of radio, TV and communication equipment and devices – 2%.

The image of innovation activity is determined by the number of implemented new technological processes. Among the analyzed businesses, 73% implemented at least one new

\(^1\) A similar method has been applied in parametric assessment of logistic centers. Companies cooperating with logistic centers are also forced to apply mathematical models while choosing a given center. In these models, moreover, it is possible to implement additional decisive variables, or functional dependencies of other sort. For example, it may be an extended production function.
technological process. The measure of innovation activity is also participation in income from selling new products (Table 2).

Table 2. Enterprises of high technology, basing on the participation of new products in sales income

<table>
<thead>
<tr>
<th>Participation of new products in business income</th>
<th>Analyzed businesses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Below 20%</td>
<td>11</td>
</tr>
<tr>
<td>20 – 40%</td>
<td>19</td>
</tr>
<tr>
<td>Above 40%</td>
<td>14</td>
</tr>
</tbody>
</table>

Source: Conditions of efficient cooperation between science and enterprises [16]

The presented data shows that participation in product innovation is crucial in considerable majority of companies. An important area of innovation activity is also time analysis of such processes (Table 3).


<table>
<thead>
<tr>
<th>Years</th>
<th>Innovative businesses</th>
<th>Businesses not based on innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td>1994–1997</td>
<td>298</td>
<td>86</td>
</tr>
<tr>
<td>1996 - 2000</td>
<td>115</td>
<td>97</td>
</tr>
<tr>
<td>1998 - 2001</td>
<td>103</td>
<td>97</td>
</tr>
<tr>
<td>2001 – 2004</td>
<td>144</td>
<td>88</td>
</tr>
<tr>
<td>2004 - 2006</td>
<td>24</td>
<td>89</td>
</tr>
<tr>
<td>2005 – 2007</td>
<td>69</td>
<td>94</td>
</tr>
</tbody>
</table>

Source: Conditions of efficient cooperation between science and enterprises [14]

The presented data shows that the percentage of innovative businesses increased from 86% to 94% in the years 1994-2007. Simultaneously, there was a decrease in participation of businesses not based on innovation. In the analyzed period of time the percentage decreased, respectively, from 14% to 6%. It needs to be underlined that the competitive determinants and access to EU funds, significantly influenced the innovation in companies. [5]

Implementation of innovation processes is a particularly complex activity in small and medium businesses. Small companies, having small capital, are interested in innovation also in a restricted scope. [11, 14, 15] Considering the medium companies, this situation is a lot more beneficial in the area of innovation. What needs underlining is the notion of help directed towards small and medium businesses in the area of innovation as part of multiple EU programs. [3]

The necessity of implementing innovation processes in businesses requires new approach to managers in the area of organization, product or technological solutions. The key problem is the pace of change taking place in global economy. [8] Innovation is this special area of business activity, that are subjected to pressure of time, due to competitiveness.

CONCLUSION

The functioning of businesses in conditions of growing globalization and with increase of competitiveness, requires adjustment processes and new ventures in the constantly changing environment. The innovation activities in businesses are definitely considered to be new ventures. Every business, for the improvement of competitive position, is forced to implement innovation processes. Such opportunities come from EU programs and projects. EU allots substantial financial resources for innovation activities. Such activities are created by intellectual capital of businesses, which enables the development of the businesses alone, as well as regions of Eastern and Central European countries. The complexity of relations in the area of innovation processes constitutes the foundation for building mathematical models, which describe the concept of business development and strategies. Parallel with theory, it is crucial to do research in economy practice, in order to improve the condition of innovation development in businesses. Research conducted in this area confirm the importance of the problem and point to the opportunities and threats for companies in the area of innovation activities.

References

Przegląd Organizacji 8/2013: p. 4-6 ISSN 0137-7221


Table 1 The directions leading to enhancement of innovation in Polish economy

<table>
<thead>
<tr>
<th>Directions of actions</th>
<th>Aim of actions</th>
<th>Area of actions</th>
</tr>
</thead>
</table>
| 1 Personnel in modern economy | Transformation of social awareness towards the idea that innovation is Poland's most important development opportunity and foundation for building competitive advantage on local, regional and international markets | - development of continuing education  
- transfer of knowledge between R&D and companies by replacement of personnel  
- innovation as an element of education adapted to modern economy demands  
- the promotion of enterprise and innovation |
| 2 Research for economy        | Increasing the application of R&D work results in companies and adjustment of potential of scientific units, for fulfilling the needs of modernizing economy; creating supply of new innovative solutions for economy | - financing of scientific and development research of companies  
- concentration of public finances on research in strategic areas  
- restructuring of public sphere of scientific units  
- internationalization of scientific and innovation-based activities |
| 3 Intellectual property for innovation | Improving effectiveness of functioning of innovation market, increasing the flow of innovation solutions, application of industrial property laws, copyright law and related rights | - support for intellectual property management  
- support for subjects applying for patents outside Poland  
- facilitating the process of obtaining protection in the area of industrial property  
- industrial design as a source of competitive advantage |
| 4 Capital for innovation      | Activation of private capital for development of innovative companies          | - facilitating access to capital for innovation-based companies  
- supporting establishment of companies based on modern technologies  
- application of tax instruments motivating to increase outlay of innovation business activity |
| 5 Infrastructure for innovation | Improving the conditions of functioning of innovative companies                | - development of institutions providing advisory and technical services for innovative companies  
- supporting cooperative actions of entrepreneurs, of network nature, directed towards innovation business activities  
- enhancement of cooperation between R&D and economy  
- popularizing the idea of application of information and communication technologies |

Source: [4]