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ANALYSIS OF THE NETWORKS OF COOPERATION OF SCIENCE AND ECONOMIES BASED ON A MEASUREMENT INDEX OF RELIABILITY METHODOLOGY

Abstract
Today, the idea of Open Innovation is a new paradigm for creating innovative business strategies. The observed increase in the educational attainment results in the availability of specialist knowledge capital outside the boundaries of research institutes, laboratories or research units of large corporations. The changing business environment forces employees to adopt "life-long learning" processes and their inter-domain and inter-subject migration. The idea of Open Innovation is realized as a combination of internal and external knowledge and ideas, as well as internal and external business models to increase innovation and develop new technologies, processes or products. The aim of the article is to analyze and evaluate the use of sources of innovation implemented by Polish and foreign companies.

Key words
paradigm, Open Innovation, strategy, innovation, capital, domain migration, subject migration

Introduction

In recent years, much attention has been paid to the idea of Open Innovation as a new paradigm in the creation of innovative business strategies. This concept was created and described by H. Chesbrough in the work "Open Innovation: The New Imperative for Creating and Profiting from Technology" [1], in which the author showed how the innovation policy of companies transitions from the so-called "closed process" to an open one. Traditionally, the process of creating innovations and new products has taken place within a company, and the ideas and inventions that were developed there seldom found themselves outside. Only a few are used in the process of improving or creating new products or included in the company policy [2] (see: Fig. 1.).

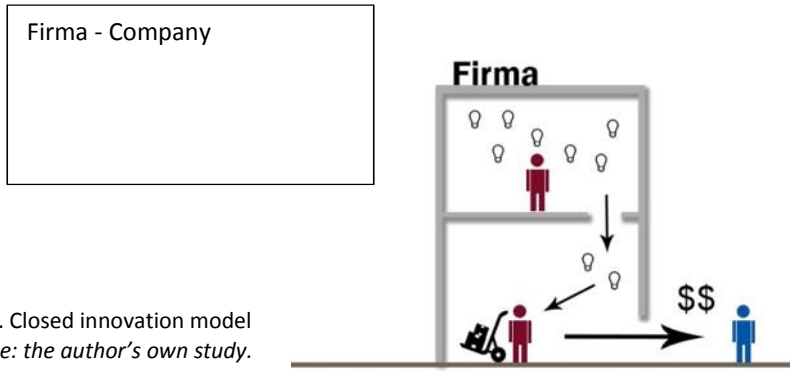


Fig. 1. Closed innovation model
Source: the author's own study.

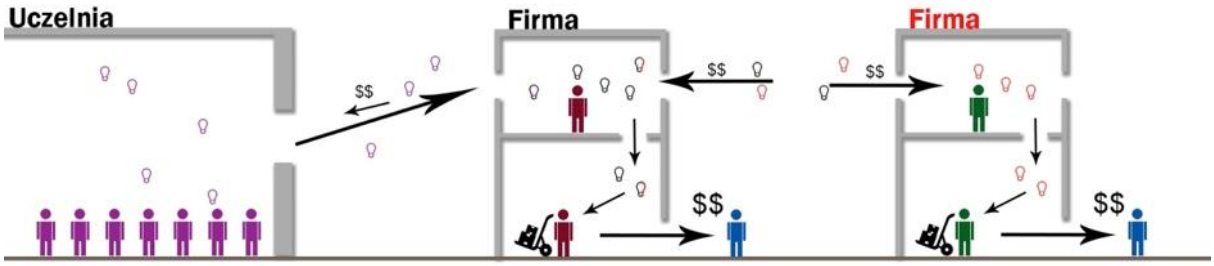
In this arrangement, R&D spending often fails to deliver the expected return, and the process of implementing new solutions and delivering a new product to the customer is long and risky [3]. In recent years, there has been an increase in the overall level of education, resulting in the availability of specialist knowledge capital outside the boundaries of research institutes, laboratories or research units of large corporations. The rapidly changing business environment forces employees to "life-long learning" processes and their inter-domain and inter-subject migration. It creates the presence of accumulated experience and knowledge. The availability of investment capital makes promising ideas and technologies relatively easy to develop outside the home institution in the form of so-called spin-offs or on a license basis. Finally, the role of suppliers and customers, for example, in

creating innovation and new values, is also growing [4]. These factors have contributed to the search for new ways to increase innovation potential. The solution can be an intensive search and use of new technologies created outside the company, as well as cooperation with suppliers or competitors to create a new market value. Another way is to license or develop ideas and technologies that do not fit into your company profile.

Thus, the idea of Open Innovation can be described as combining internal and external knowledge and ideas, as well as internal and external business models to increase innovation and develop new technologies, processes or products (see: Fig. 2). As shown above, the enterprise is not required to have an expensive internal R&D department, and innovative solutions may come from other sources that directly derive from the location of the company on the market (see: Fig. 3).

Fig. 2. Open innovation model

Uczelnia – University; Firma – Company;



Source: the author's own study.

Dostawcy – Suppliers; Uczelnie – Universities; Inne firmy – Other companies; Klienci – Clients; Firma - Company

Fig. 3. Potential external sources of innovative solutions
Source: the author's own study.

The following are examples of the use of individual sources of innovation that have been implemented by other Polish and foreign companies.

Own company

To effectively implement innovative solutions in a company, an R&D department is not necessary. Employees who usually have extensive experience are often the source of great ideas. The German companies Bosch and Viessmann are examples of companies that have bet on their creativity and innovation.

For Viessmann, which has been producing heating systems for generations, there is a simple suggestion system that employees can propose in individual factories through special paper forms. Bosch also follows such practices, but the system is much more sophisticated and takes the form of a web site, while providing greater control over the process itself. Both companies pay special attention to confidentiality, intellectual property rights, and apply a premium system if the solution suggested by the employee is useful and is implemented.

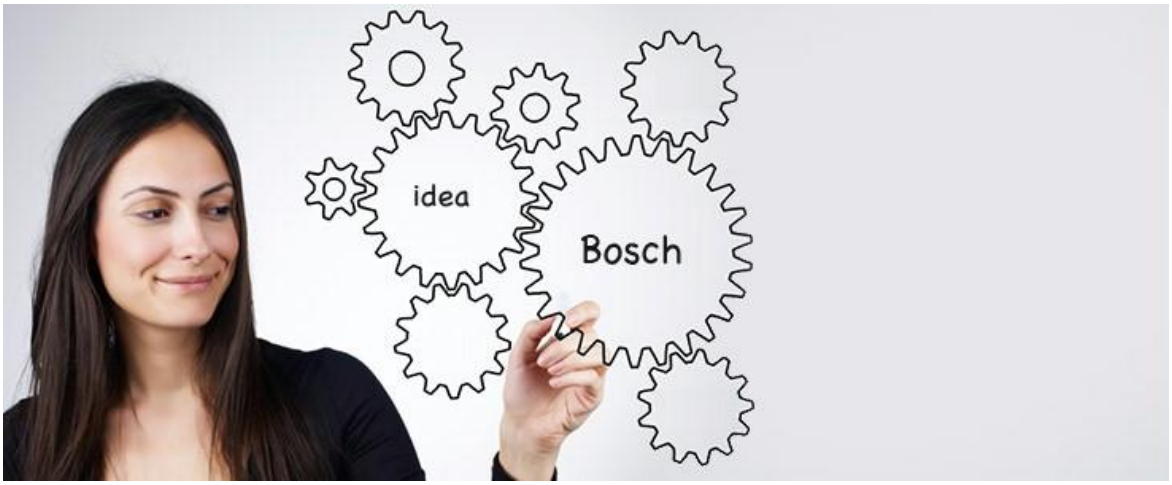


Fig. 4. Idea of Bosch
Source: own materials.

Suppliers

Tetra Pak develops comprehensive solutions for food storage. However, during its more than 50 years of operation, the company encountered numerous problems when creating new products. One such problem was the possibility of pasteurizing the products stored in glass bottles or metal cans. To address this problem, the company asked its suppliers to propose different materials that would be more resistant to pasteurization than existing cardboard cartons. The result of this collaboration was a new packaging consisting of three layers: thick coated paper, aluminum foil and polymer foil. Thanks to the technologies used, the packaging is ideally suited for storing juices, milk and other beverages and is currently one of the company's best-selling products.

Clients

Potential customers of any company can discover the unused innovation potential. This potential was taken advantage of by SITAG FORMY SIEDZENIA, which organized a competition. Customers and artists were invited to participate in the competition. Its purpose was to design a new line of chairs, which in their form had to deviate from the standard offer of the company and lead to the emergence of an exclusive product. SITAG Formy Siedzenia has received about 3,000 submissions with various designs, from which 11 have been selected. The winning designs enabled them to create the first series of Premium chairs. The prize for the laureates is a share in the profits from the sale of each chair they designed. It is worth noting that the collection is open. The producer announces the subsequent versions of the collection, encouraging co-designers and customers themselves to collaborate.

Fig. 5. Competition information
Source: own materials.

Universities

Philips Healthcare is an example of a company that using innovative solutions from universities. The company asked the students and staff of Eindhoven University of Technology to help develop software that could help in the elaboration of reports and management of existing documents. The Datamind program was created in response to this request. Its purpose is to provide real-time solutions to problems reported by employees. The operation of the program is based on intelligent searching of databases consisting of reports, studies and analyses. After recognizing the keywords used in the description of the reported problem, the program presents the solutions used by the authors of the searched documents. Datamind is integrated with Microsoft Office, and its operation is almost imperceptible. The solutions proposed by the program also include the author's contact information, which in turn motivates and encourages discussion in direct contact and leads to improved solutions.

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Other companies

A source of innovation in a company may also be discoveries and patents developed in other companies. Examples of such cooperation can be PaloAlto Research Center derived from Xerox, which in their output have achievements such as a computer mouse, icons and the graphical user interface. These elements now constitute the basis of every operating system. The solutions developed by PARC were later purchased by companies such as Apple and Microsoft.

Good practices in information processing in science and technology networks

The "Open Information Processing within Innovation Networks" (InfoPro) project aimed to improve the flow of information and data in innovative networks in Poland, Germany, the Netherlands and Hungary. Through the transfer of best methods and tools, the project contributed to increasing the network members' ability to implement innovation in a more effective and open way.

InfoPro was part of the "EURIS - European Collaborative and Open Regional Innovation Strategies" project, which aims to strengthen interregional cooperation in the field of research and development, and thus support the creation of Regional Innovation Strategies through the exchange of knowledge, experience and good practice. The InfoPro project has used the Measurement Index of Reliability methodology, which evaluates good practices in each region, presenting ways of processing information in implementing networks, or preparing for the implementation of the Open Innovation paradigm.

The theoretical background of the Measurement Index of Reliability (MIR) methodology

MIR measures the ability of the business process to respond to unexpected events. The methodology was used to examine the process of creating new products in a variety of industries such as the electronics, telecommunication, medical or processing industries. It evaluates the maturity of the information process during the development of new products in three main stages:

- Stage I - measuring and evaluating new events in the business process. If such events occur, and the chances they bring about are not well appreciated and identified, it will not be possible to react to them.
- Stage II - communicating and informing about the events. It is imperative that participants in the process are aware of the new possibilities.
- Phase III - analysis of the genesis of the events and control. If the event source is specified, it will be possible to take appropriate countermeasures.

Each stage is assigned one of the 5 MIR levels:

- MIR 0 - no control and measurement for the event,
- MIR 1 - event measurement,
- MIR 2 - measurement and identification of the origin of the event,
- MIR 3 - measurement, identification of origin and cause of the event,
- MIR 4 - ability to predict similar events in the future.

Characteristics of MIR levels

MIR 0: Exposure

Theoretical assumptions: The information has been revealed, but network members are not necessarily aware.

This is usually the first stage in the development of any project. The information is prepared and categorized, but there is no clear interaction with network members. In the Open Innovation environment, network members need to feel free if they want to develop and publicize their projects. At this stage, an emotional approach to the subject, one that motivates and inspires, is important. However, there should be a balance between the aspects and a professional and substantive description.

MIR 1: Dissemination

Theoretical assumptions: Information has been given to specific partners, but at this stage they are not aware of its usefulness.

The information environment is very important at this stage. It should be user friendly and combine aesthetic and functional elements that provide intuitive and easy access. This will allow for interest and involvement, and will ultimately contribute to dialogue. At this stage, social media prove to be useful to reach a broader audience and to contact the sender.

MIR 2: Sharing

Theoretical assumptions: Information has been made available to partners with a specific profile, but they are still not aware of its usefulness.

Sharing at this stage is initiated by several factors:

- the need to share information,
- the partners searching for a specific solution,
- the common interests of the partners,
- the context,
- trust while passing on the information.

MIR 3: Integration and creation of new values
Theoretical assumptions: The information has been disseminated, and various parts (or the entirety) thereof have been integrated, which in turn contributes to the creation of new intellectual or material values.

At this stage, specific and specialized tools are useful, integrating various types of information while maintaining constant communication.

In this part of the paper, attention will be focused on the MIR methodology adopted for the InfoPro project, which investigates the effectiveness of information flow in networks operating with or implementing the OI paradigm.

MIR was used to verify the tools used to process information in existing networks in Poland, Germany, the Netherlands, and Hungary. A check was performed on whether they could support the innovation process, from managing its flow, reacting to unforeseen events, and as a result, creating new values.

MIR levels are defined as follows:

- MIR 0 - The tool can reveal information, but network members at this stage are not able to evaluate it.
- MIR 1 - The tool provides easy access to information, but network members are still unable to determine its relevance.
- MIR 2 - The tool allows selective sharing of information to network members who may be interested in it. However, its usefulness is still unclear.
- MIR 3 - The tool contributes to integrating and generating new values. The information is provided to the relevant partners who are seeking it. It is clearly described and is a valuable asset in the production process.

Based on the above-mentioned modified levels of MIR evaluation, examples of good practice were evaluated, which allowed for observing the differences and understanding the key factors increasing efficiency. In each of the participating regions, a joint discussion was held to become familiar with the tools used and to evaluate them using the MIR scale positioning.

Analysis and evaluation of selected projects
Zala Region - Hungary

One example of cooperation between companies, leading to the creation of an innovative solution, is the HY-GO project. It was created in cooperation with universities and private enterprises. Its goal was to create an environmentally-friendly hydrogen-powered vehicle that would also become a symbol of cross-sectoral collaboration. The level of maturity in the processing of information in the project described is MIR 0.

This is because in the Zala region, current practices are mostly focused on building examples that are intended to encourage cooperation aimed at innovation.

To improve and enhance the impact of the HY-GO project, it would be beneficial to create a platform that would allow other members to engage in the development of the project. In addition, such a solution would allow closer cooperation between the project developers and at the same time contribute to its promotion via the Internet.

Brainport-Netherlands
Datamind, developed for the improvement of the medical services systems, is another project. The program provides up-to-date solutions to problems reported by employees that serve patients. The operation of the program is based on intelligent searching of databases consisting of reports, studies and analyses. After recognizing the keywords used in the description of the reported problem, the program presents the solutions used by the

authors of the searched sources. Datamind is integrated with Microsoft Office, and its operation is almost imperceptible. The solutions proposed by the program also include the author's contact information, which motivates and encourages discussion in direct contact and leads to improved solutions.

The level of maturity in the processing of information in the project has been evaluated at >MIR3. Emphasis is put on combining different information through a system of hints, creating new knowledge by compiling information from different fields, while allowing a general view of the current stage of the project (goals, key accomplishments).

In the Brainpoint Region, the implementation of tools for many levels of MIR was observed. The stronger ones were at MIR 2 and >MIR 3; however, interesting results were achieved through the implementation of MIR 1 and MIR 0 tools. The >MIR 3 tools support the development of knowledge through enhancing the possibility to create new solutions. MIR 2 tools are mainly used to show future perspectives for decision-making support. MIR 1 tools support access to information by helping to find dependencies, creating outlines and reliable structures. Also, they are flexible and easy to use. The interesting feature of MIR 0 is the support and highlighting of certain aspects by raising interest in people.

One of the most important issues facing Brainpoint is the proper alignment of intellectual property regulations.

Stuttgart - Germany

An example of a tool allowing to collect on-line information about customer needs and to simultaneously generate proposals of 3D-CAD technology solutions to address the reported problem is the 3D Fitness Check project. The level of maturity of the project in terms of information processing was assessed to be MIR 2. Stuttgart also uses other tools rated as being within the MIR 0-3 range. Digital data processing tools, such as Tech Alert, Newsletter, or Knowledge Base, are widely used. Local and global information is readily available and it also incorporates the social aspects of communication. Unfortunately, there are insufficient opportunities for direct exchange of information between network members.

Łódź Region

An example of a project implemented in Łódzkie is the project Bioenergy for the Region - Integrated Doctoral Student Development Programme. Interdisciplinary groups of doctoral students, working on common solutions for business entities in the field of renewable energy were formed within its framework. Thanks to the support of experts and enterprises, a platform has been created for sharing information and ideas and deepening the cooperation between science and the economy. The level of maturity of the project in terms of information processing was assessed to be at the level of MIR 2 up to MIR 3. Other network information processing tools used in Łódzkie were evaluated at MIR 0 to MIR 2 level.

The Bioenergy for the Region cluster and its coordinator - the Pro-Akademia Research and Innovation Center - are strongly interested in implementing new solutions and repeating tools for categorization and further distribution of data. Such a database will allow for increased support for cluster members and will also contribute to increased information flow. This will in turn positively influence the development of the Open Innovation idea.

Conclusion

The idea of Open Innovation, a new paradigm for creating innovative business strategies, is finding increased use in practice. In many companies, the idea of Open Innovation is realized in the form of combining internal and

external knowledge business models, and ideas. It results in increased innovativeness, development of new technologies, processes or products. When analyzing and evaluating the use of sources of innovation implemented by Polish and foreign companies, one can observe that:

- Improving and enhancing the impact of the HY-GO project requires the creation of a platform that would foster the involvement of individual members in the development of the project;
- Creating a platform for the HY-GO project may lead to closer cooperation between the project's creators and contribute to its promotion through the Internet;
- The Datamind project is integrated with Microsoft Office and its operation is almost imperceptible; the Datamind project contributes to increased motivation and creative discussion, leading to improved solutions;
- In the Datamind project, the emphasis is put on combining different information through a system of prompts, creating new knowledge by compiling information from different fields, so that a general view of the current stage of the project is possible;
- In the Datamind project, support of the development of knowledge by enhancing the possibilities of creating new solutions occurs;
- The tools in the Datamind project show the future prospects for decision-making support, they support access to information, and provide flexibility and ease of use;
- The 3D Fitness Check is an example of a tool that enables gathering of online information on customer needs and simultaneous generation of 3D-CAD technology application proposals;
- In the 3D Fitness Check project, local and global information is not only easily accessible, but it also combines the social aspects of communication;
- The drawback of the 3D Fitness Check project is that there are insufficient circumstances conducive to the direct exchange of information between members of the network;
- An example of an OI-oriented project in Łódzkie is the Bioenergy for the Region - Integrated Doctoral Student Development project;
- The Bioenergy for the Region - Integrated Doctoral Student Development project brings together interdisciplinary groups of doctoral students, and developing common solutions for business entities in the field of renewable energy sources;
- Bioenergy for the Region has a platform for sharing information, sharing ideas and deepening the cooperation between science and the economy
- The Integrated Doctoral Student Development Program is committed to the implementation of new solutions and tools for the repetition of information, enabling the categorization and distribution of data to facilitate the flow of information.

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