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THE ROLE OF TECHNOLOGY PLATFORM IN THE PROCESS OF KNOWLEDGE MANAGEMENT

Key words

Technology Platform, network cooperation, knowledge management in the commercialization process.

Abstract

Knowledge management takes on various forms depending on the character of the enterprise, the specificity of the industry, and the adopted strategy. The technology platform model created at the Research Institute is a tool supporting the process of knowledge management and particularly the process of the knowledge codification. The platform allows both the codification of the knowledge of partners and projects, and the accumulation of knowledge about innovative technological solutions. The platform allows the dissemination of knowledge into the economy. Moreover, it identifies the needs and expectations of the market in the field of innovative technologies. The article presents the best practices in the functioning of the Technology Platform as an operational mechanism in knowledge management for the process of commercializing R&D results conducted in the scientific research units.

Introduction

Since the globalization processes (and with them the technological advancement) have been intensifying, the more extensive the network between businesses and research and development units, the better are its chances to maintain a competitive advantage in the market. An important aspect of building a strong economic position of the business is not only skilful management of resources, such as, property, finances, and information, but primarily the effective development and use of their competencies, and adequate knowledge management. In the age of globalisation and internationalisation, any economic entity that wants to develop and strengthen its position on the market must be innovative, and this is possible through the acquisition and use of knowledge. An adequate knowledge management process affects the pace and nature of innovative activities and the creation of technologically advanced products.

The requirements of knowledge-based economy present new challenges for research and scientific institutions, particularly in the process of commercializing R&D results, where it becomes important to implement research motivated by the needs of the market. The transfer of knowledge is not only the implementation of the R&D results into the industry, but also a wide range of cooperation between the scientific community and entrepreneurs in solving business and production problems.

The conducted analyses indicate that the level of cooperation between research institutions and businesses in Poland is still unsatisfactory, encumbered with multiple obstacles [16]. The proportion of companies declaring cooperation with researchers is 75–80% in foreign countries, whereas, in Poland, this cooperation is lower by more than 30% [6].

One report [25] indicates that 20% of Polish entrepreneurs do not have knowledge about the possibilities of cooperation with the scientific community, while almost 40% of the companies do not know how to reach the scientific units designed to commercialize research.

One of the ways that can contribute to the improvement of the cooperation between science and business, and can support the process of knowledge management, is building a cooperative network.

International experience suggests that network forms of cooperation provide benefits to both research institutions and businesses; they intensify processes of commercialization, eliminate negative phenomena on the labour market, and increase the competitiveness of the companies.

Moreover, the conducted analyses indicate [29] that network cooperation facilitates the process of collection, processing, and the use of knowledge, and the transfer of technology; it advances communication among the parties interested in the implementation of innovations. Networking cooperation brings benefits of scale, increases innovation processes in companies, and it allows the transformation of knowledge into products by providing concentrated

operational tools, often including financial resources necessary for that process, which would be impossible to amass within one enterprise, in particular, in the SME sector.

Networks can be created through the construction of project consortia (e.g. Industriell Dynamik, Sweden) or based on Web applications (e.g. Madri+d, Spain). Cooperation networks help businesses in initiating innovation-related activities (e.g. Syntens, Netherlands), promote the development of research and innovation stimulating policy (e.g. Setn, United Kingdom), organise conferences, fairs (e.g. Syntens, Netherlands), offer support in finding partners for projects and trade partners (e.g. NanoBioNet, Germany). Technology Platforms aid the conversion of solutions that are research results into innovative products, processes, and services that generate added value (e.g. Jinnove, France), promote the development of start-up and spin-out businesses (e.g. Yet2. com, USA), deal with economic consulting for businesses (e.g. Syntens, Netherlands), run support programmes for entrepreneurs, for example, in the form of grants (e.g. Jinnove, France), carry out marketing activities in support of entrepreneurs (e.g. Syntens, Netherlands), engage in the promotion of science and technology and offer internships, scholarships, training (e.g. Syntens, Netherlands, Madri+d, Spain) [29].

In order to strengthen the cooperation between science and business, the Institute for Sustainable Technologies – National Research Institute (ITeE – PIB) initiated the creation of a technology platform model, which presents the results of the scientific research and development projects conducted at the Institute, ranging from advanced material technologies, modern mechatronic systems, control systems, IT applications, to technical safety and environmental support systems, and experimental and testing equipment. Knowledge management in the platform includes product and process solutions that are the result of the implementation of the Strategic Programme: "Innovative Technical Support Systems for Sustainable Development of the Economy" and the results of other research and development projects.

The article describes the use of a technology platform as a support tool for knowledge management in the improvement of cooperation efficiency and as being conducive to removing barriers that occur among participants in the process of commercializing the R&D results.

1. State of the art – knowledge and knowledge management

A survey of literature on the subject indicates that there is some ambiguity in the understanding of the "knowledge" concept [13, 19, 22].

Knowledge can be defined as the totality of competences and information used by the employees to solve problems. It contains both theoretical and practical elements, and general and detailed guidelines for action. Knowledge

base is provided by data and information; however, knowledge always is related to a specific person [24].

For the purposes of this study, the definition proposed by the Jashapar has been adopted. It defines knowledge as an effective learning process, related to the search, use, and dissemination of knowledge (explicit and implicit), using appropriate technologies, and cultural environment, the purpose of which is to increase intellectual capital and the efficiency of the organization [12].

Following M. Polanyi, implicit knowledge exists only in the mind of the person who possesses it; it is formed by experience and is not fully conscious, manifesting itself only through capable action. On the other hand, explicit knowledge is expressed in the written form and saved on the knowledge media [23].

Knowledge management in organisations has become a key concept of management theory and practice. It is extensively described in the literature [4; 26; 9; 15]. General definition of knowledge management (Schermerhorn) says that knowledge management is "a process of using the intellectual capital to gain competitive advantage" [18].

From the point of view of strategic management, knowledge management is understood as managing the function responsible for the regular selection, implementation, and evaluation of the purpose-oriented strategies, aimed at the increase of the value of the organization through the use of explicit and implicit knowledge for the improvement of its functioning [18]. In this sense, the term "knowledge management" means the improvement of organisational abilities at all levels of the company for a better use of knowledge resources. Thus, it can be seen as the management of activities and processes that can raise the efficient use of knowledge and thereby the competitive ability. The efficient use of knowledge means that gained knowledge has to be purposefully integrated in the development of products and processes [14].

Knowledge management in a scientific research institution is a process through which a research unit can become fully competitive in the ever-changing market. Conversely, knowledge management in an enterprise can be defined as the set of actions undertaken by management and employees, whose aim is the attainment of specific tasks.

The general purpose of the knowledge management application in any organization is to facilitate the recognition of knowledge by the management as a resource and to inspire it to seek practical applications of this resource [24]. Viewing knowledge management more analytically, it can be regarded as the following [27]:

- A basic tool of future management;
- An opportunity for a radical reorientation in ways of thinking;
- An effective and efficient tool for improving quality;
- A collection of experience and intuition that make up the platform for the creation and absorption of new experiences and information; and,
- An opportunity to reveal the existing areas of knowledge insufficiency.

The objectives of knowledge management defined by R. Maier [18] are the following:

- Obtaining transparency of knowledge;
- Implementing documentation of knowledge;
- Changing organizational culture;
- Improving communication and cooperation;
- Transforming implicit into explicit knowledge (externalising), improving educational processes, training, and networking for newly recruited employees;
- Improving the processes of employees' development;
- Improving knowledge retention (organization memory);
- Improving access to existing knowledge;
- Improving knowledge distribution;
- Improving innovation management;
- Reducing cost; and,
- Sales knowledge.

Knowledge management system[1] can be defined as set of rules, methods, resources, collections of information, people and their interconnections, which allows accepting and implementing the strategies and objectives of knowledge management for the achievement of the objectives of the organization.

2. Knowledge management within the network of cooperation

The requirements of a knowledge-based economy result in knowledge being perceived as a strategic resource, and the transfer of knowledge, based on the communication within the network of cooperation, has a crucial importance for innovation processes. Relevant literature increasingly underlines the importance of external resources to which the unit has access to through the network of relationships [10], and which translates into achieving a competitive advantage on the market. The network can be defined as a set of specific relations among defined groups of people, objects, or events [20]. In organisation sciences, a network is defined as a system or area consisting of organisations and inter-organisational relationships [8]. This article defines network as a long-term relationship among partners, connected by ventures that delineate the scope of their cooperation [29]. The results of empirical studies confirm that networks and goods associated with a particular relationship provide access to resources that may not be available in the traditional market exchange, help build competitive advantage [2], and increase innovation level among the network members [5, 1].

Networks are crucial to the development of processes related to the creation, diffusion, absorption, and use of knowledge. Companies in the network more

[1] Ernst & Young defines it as „a system designed to help businesses in the acquisition, analysis, and use of knowledge in order to make faster, smarter, and better decisions leading to the achievement of competitive advantage" [28].

frequently have connections to knowledge resources, which enable them to acquire more precise knowledge, share it [11], and use it for the development of new business concepts [7].

Knowledge management in the context of network cooperation requires activity in the field of explicit (possible to codify) and implicit (know-how) knowledge, where types of knowledge are complementary to each other, and both are necessary in the process of knowledge management. Explicit knowledge can be communicated, processed, and stored relatively easily, while implicit knowledge is difficult to formalize and communicate and requires specific competences.

Another important aspect is the expected return on knowledge sharing, which affects the relationship with the participants within the network, since it is the expected profit for sharing knowledge. Knowledge within a network can be formal or informal. The formal form includes structured inter-organisational teams, joint training, conferences, or systems based on IT (e.g. Internet platform). Knowledge made available in this way is explicit. Sharing knowledge in an informal way is based on the "relational" channels that allow face-to-face communication and encourage a climate of trust among the network participants. An important factor is also the culture of network cooperation (conflict resolution).

Creating a network of knowledge-sharing cooperation facilitates the process of generating new ideas and the management of innovative projects, improves the time and cost efficiency of network participants, and creates added value. It often leads to the implementation of (product, process, service, marketing, organizational, institutional) innovation.

Networking cooperation is a system of knowledge management within which collective activities are conducted, which are varied in terms of industry, meeting the variety needs of the network participants' market. A significant value of such an organization is not based on the ready and defined character of a product, but on meeting the diverse and complex needs of the customer.

3. The concept and the main objectives of the Technology Platform

In the age of the changing face of a modern scientific research, the Institute for Sustainable Technologies – National Research Institute has created a model network of cooperation – a Technology Platform that integrates science and economy.

The Technology Platform (Fig. 1) promotes innovative processes and product technologies, creates effective structures and mechanisms for the transfer of innovation, and assesses the effectiveness of these structures. Moreover, there are analyses conducted concerning potential growth areas for innovation, resulting from the needs of the industry (mainly regional), and trends in the economy. There are IT tools created to facilitate the process of collection, processing, and use of knowledge, and also technology transfer, all to improve the communication among innovation stakeholders.

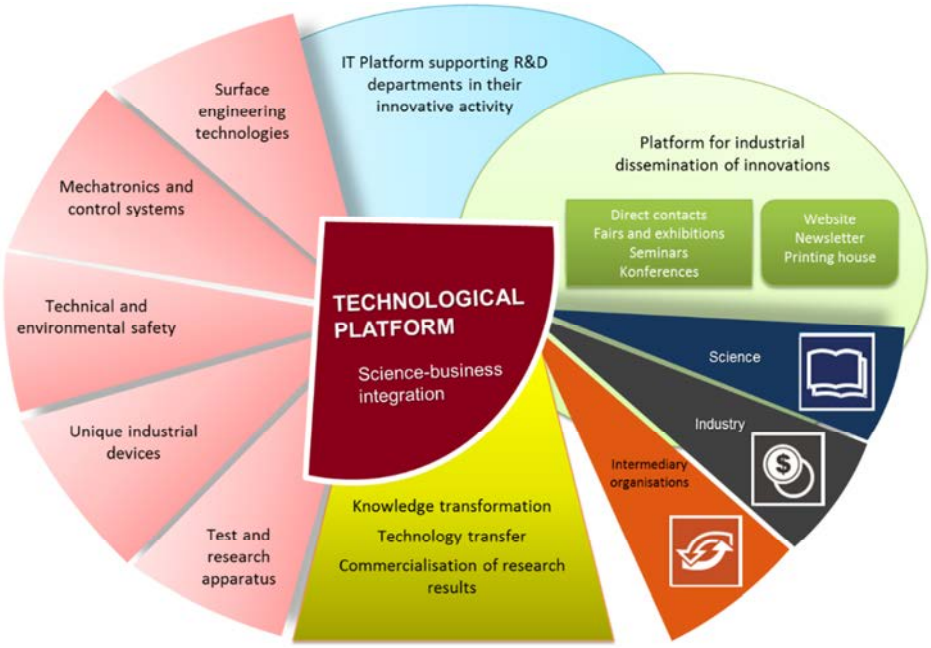

Fig. 1. Technology Platform

The qualities justifying the creation and functioning of the Technology Platform (which, unlike most such entities operating on the Polish market, is not financed with external (budgetary) resources) include the following:

- It provides a knowledge dissemination tool through the exchange, acquisition, and application of innovative solutions on the regional scale, and their transfer within the cooperation networks.
- It creates an accumulation of knowledge from different areas of competence and experience, which are helpful in solving complex, innovative, technical, and technological problems.
- It allows collecting, analysing, and processing information.
- It represents a source of creative, innovative solutions, tailored to the needs of regional and national markets.
- It creates a pro-market approach of scientific research units and the implementation of planned projects.
- It increases the phenomenon of the synergy of competences among the network participants.

The tasks carried out within the platform allow effective coordination among its members, facilitating the establishment of business contacts, and they influence building partnerships, simplify the path and the implementation of joint ventures in the form of contracts, projects, and thus create opportunities and significantly reduce the traditional means of achieving success on the market.

4. The model of knowledge management within a Technology Platform

The Technology Platform created in ITeE – PIB facilitates the process of knowledge acquisition and dissemination, and it can be simultaneously used within different scopes. Knowledge management within the network cooperation refers to communication of know-how, the creation of new concepts, and it undoubtedly is of great importance for creating innovation processes among the participants of the network. The proposed knowledge management model is implemented in the created Technological Platform.

The model consists of three main components (Fig. 2):

1. Correlation module generates interaction among network participants, defines their knowledge, and specifies the state of knowledge by the Institute necessary for cooperation, enabling a definition of the position of each its members in the network.
2. Operational module of knowledge management includes the following activities:
   - Acquiring knowledge (from internal and external sources); and,
   - The dissemination of knowledge – a developed form of knowledge sharing in order to make given knowledge generally available.
3. Diffusion module, including the transfer of knowledge, is a mutual transfer of knowledge in the process of communication. Moreover, identifying the knowledge that should be acquired, transferred, manufactured, thanks to the projects by the platform, for both its participants and entities outside the network is included in this module.

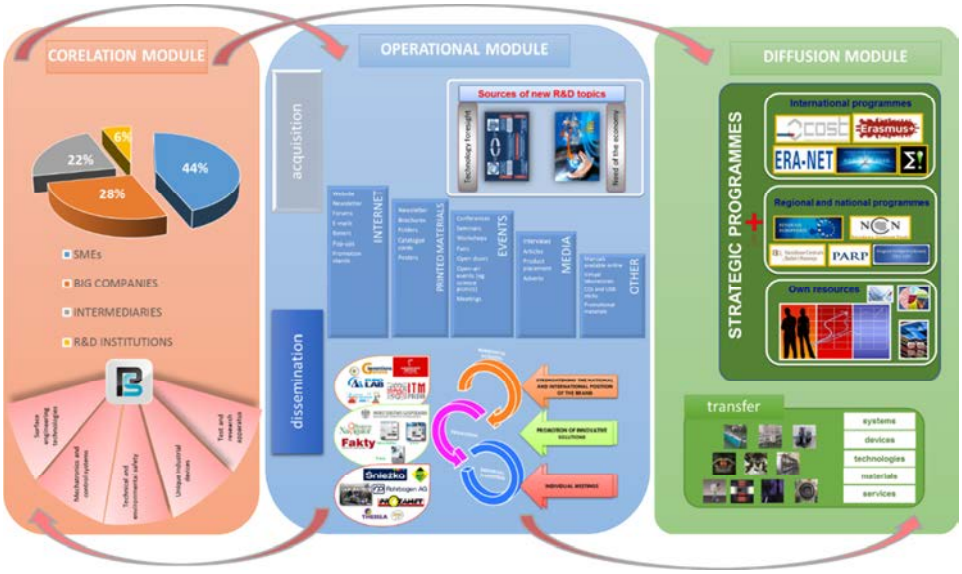

Fig. 2. Knowledge management model within the network

Correlation module

The Technology Platform created in ITeE – PIB is addressed to recipients from across Poland, in particular to entrepreneurs, institutions in the business environment, and scientific research units, as well as to foreign organizations. The platform has a formal structure in which the official participation is confirmed by signing the document "Declaration of creating a platform for the dissemination of innovative solutions in the economy". So far, more than 40 economic entities joined the platform structures. Mostly these are companies, and they account for nearly 75% of all members of the platform, of which 60% are representatives of the SME sector, and 40% are representatives of large companies. Its backbone is formed by companies located or having their branches in Mazowsze.

This entity has an open structure, which can include other partners who share the objectives of the platform and who see the benefits they can obtain in cooperation within its framework. The platform, which is a network structure, brings benefits for its direct participants, and it indirectly generates many positive effects for the environment (Table 1).

Table 1. Benefits for the participants of the Technology Platform

Benefits for the Institute	**Benefits for platform members**
❑ The development of innovative service area ❑ Increased interest in the offer of the Institute ❑ Commercialization of innovative solutions	❑ The use of new knowledge and innovative solutions ❑ Taking action resulting in the implementation of innovative solutions in companies ❑ Cost optimization in the business

The purpose of the first module is to identify relationships that may occur with individual partners. They can be both vertical in nature (reflecting the classic supply chain) and horizontal (e.g. competitors, which are other scientific research units or the companies in the business environment).

Identifying and developing a relationship of cooperation between the Institute and the network participants in the network, as a consequence their suppliers, contractors, customers, and service providers, ensure co-operation, provides increased collective performance, and increases efficiency in the implementation of innovative products, together with the recommendations made by the direction of the manufacture of technologically advanced solutions. Each participant is additionally characterized in terms of ownership type, its industry, or areas in which cooperation may occur. For companies, especially in the SME sector, participating in a network form of organization affects the

growth of innovation, raises competitiveness, and, at the macro-economic level, stimulates business development.

The operational module

Network participation allows sharing, exchange, and use of know-how by the members of the network, providing access to knowledge, its collection, the transfer of experience and competence, and the use of knowledge to create innovation. There are two main sources of acquiring knowledge within the platform:

- Foresight-type analysis to select future-oriented research in accordance with market demand and research directions; and,
- The demand for knowledge from direct industry input, resulting in the creation and development of innovation-generating projects of a commercial nature, the effect of which is to implement a new product or new technology on the market.

Effective coordination and configuration of the platform work, characterized by creative relationships with partners, allows the dissemination of innovation among the participants and beyond. To this end, an operational procedure was created for the dissemination of innovative solutions consisting of 7 stages: market situation analysis, the segmentation process, creating a distinguishing feature of solutions, marketing strategy development, the dissemination phase organisation, the follow-up phase, monitoring the effects of dissemination, which together form an Innovation Dissemination System [30] (Fig. 3).

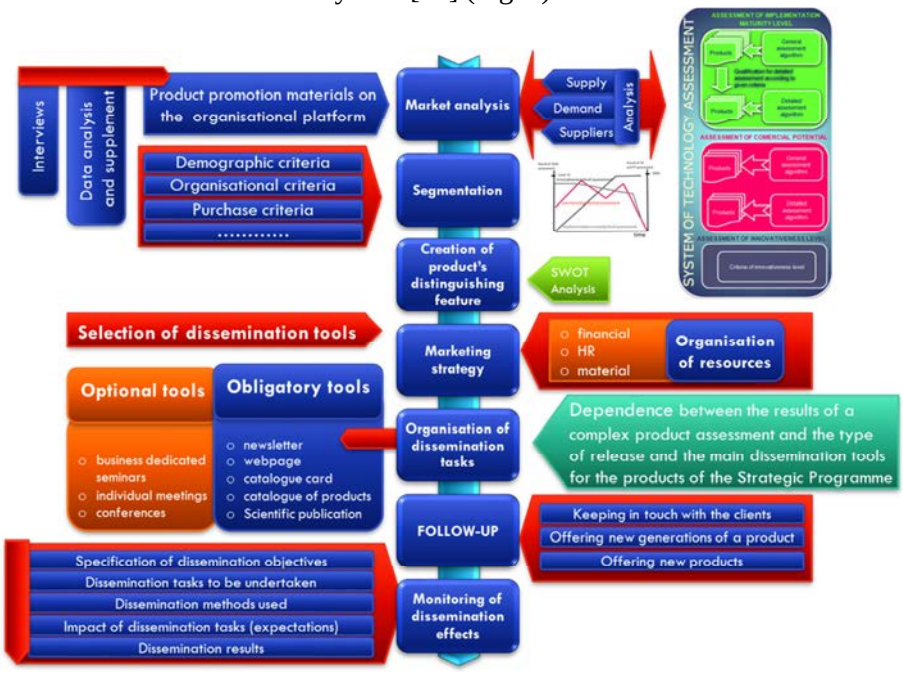

Fig. 3. A system of dissemination of innovative solutions

This system of the dissemination of innovative solutions has been tested on dozens of examples and is used at the Institute for research results created there, R&D, and implementation projects. One of the tools to support dissemination is the comprehensive technology assessment system created in the ITeE – PIB, which consists of an assessment of the degree of implementation maturity (SDW), an assessment of the commercial potential (PK), and an assessment of the innovation level (PI) of technologies, products, and process solutions, which allow an in-depth analysis of application technology [17].

Thanks to the systemic approach in the dissemination of R&D results, their efficiency has increased, for example, by concentrating on providing information on finalised results, as in the Strategic Programme, implemented at the Institute, "Innovative Technical Support Systems for Sustainable Development of the Economy", where entities using similar solutions (producing a success by relevant communications, using effective operational tools, for the respective target groups). Dissemination activities influence the development of cooperation between the Institute and the enterprises interested in the implementation of innovation. Moreover, they facilitate carrying out systemic activities related to the promotion of the innovative process and product technologies created during the ongoing projects at the Institute.

One form of effective communication used by the platform is the organization of cyclical seminars, whose primary purpose is (in addition to presenting the scope of scientific research, project and implementation work of the Institute for Sustainable Technologies – PIB) to establish and intensify cooperation between the representatives of businesses and the Institute. So far, seven such meetings have been held, in which 170 representatives of the economic sector participated from all over the country, and (II) editions of the Business and Science Conference "Engineering the Future" (September 2014, May 2015) were organised with more than 300 participants[2] in attendance. The main objectives of the conference was the integration of the scientific community with the economic environment, increasing the cooperation between science and business, and the promotion of the application types of technological and system innovations developed by the R&D sector units or centres and research laboratories at companies.

Diffusion module

The initiatives undertaken within the platform intensify activities undertaken at the Institute for the commercialization of research results (sales, services, licensing, the creation of spin-off entities), and thus lead to the strengthening of the position (brand) of ITeE – PIB in the social, business, and scientific community. They ensure, through the mutually beneficial ties, strengthening partnerships, building a strong foundation for the development of

[2] http://www.future.engineering.itee.radom.pl/

knowledge, skills, abilities, and competences of all the participants in the network.

Through the Technology Platform, joint initiatives undertaken by scientists and entrepreneurs, and projects with a high implementation potential, are created and developed. As a consequence, direct contracts from the industry for the Institute have increased.

Examples of subjects and projects carried out at the Institute include the following:

1. Surface engineering:
   - High heat resistance coatings to increase the durability of the mould for pressure aluminium die casting for the aerospace and automotive industry;
   - Technology of increasing the durability of special tools for the metal industry.
2. Mechatronics and optomechatronics:
   - Automatic optical inspection systems and qualitative selection the tobacco industry;
   - Hybrid video systems for monitoring technological processes for the glass industry.
3. Pro-ecological technologies:
   - Optimization of water and wastewater management (reduction of water consumption and waste water disposal) for a company in the chemical industry;
   - Manufacturing technology of pro-ecological greases for the sugar industry.
4. The production of prototypes:
   - Range of equipment for testing mechanical properties of furniture elements;
   - Technological equipment for efficient recovery of working fluids from metal shavings in large-scale production for the metal industry.

The indirect effects of the platform's functioning are contracts for the Institute for industry expertise, opinions about innovation, and conducting technical analyses. Because of the high quality of services, access to specialized laboratories, and punctual work, the number of entrepreneurs benefiting from services provided by the Institute increases steadily.

Cooperation within the platform allows undertaking joint initiatives and innovative activities, using a variety of unique skills, and creating a specialized configuration of the competences of the participants in the network, which greatly increases the effectiveness of combining the world of science and business. An important aspect is increasing the involvement of companies in science and research, and in joint applications for funding for projects from external sources – regional, national, and international.

Conclusions

The requirements of a knowledge-based economy affect how the new relationships between the world of science and business are defined, and the transfer and commercialisation of R&D sector knowledge to the economy becomes a key factor that allows gaining and maintaining a competitive advantage. One of the tools that make it possible to more effectively implement and commercialize the R&D results is a Technology Platform.

Knowledge management within a scientific research unit established in the form of network cooperation allows generating an added value in terms of the following:

- Improving the effectiveness through promotion of best practices, concepts, and the development of projects firmly planted in the economic environment;
- Increasing loyalty by developing and building enduring relationships within network partners, customers, suppliers, and increasing the quality of these relationships, which are shaped by the level of mutual trust;
- Increasing chances for future success by creating product innovation, reducing the time of implementation, and upgrading products and matching them to market requirements;
- Creating culture based on the paradigm of values by shaping attitudes, and competences for generating values for the society and the economy; and,
- Increasing the effectiveness of decision-making by making relevant decisions, thanks to the information supplied to the competent persons at the right time.

The network of connections created within the platform is a system built with great care, consisting of interrelated components that make up the competitive forces throughout the organizational network. The platform, through its activities, reinforces member integration within the network, facilitates knowledge coordination processes, enables the development of the skills of its participants, and (on the macro level) supports building a knowledge-based economy through the implementation of R&D innovation.

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Rola Platformy Technologicznej w procesie zarządzania wiedzą

Słowa kluczowe

Platforma Technologiczna, sieciowe formy współpracy, zarządzanie wiedzą w procesie komercjalizacji.

Streszczenie

Zarządzanie wiedzą przybiera różne formy w zależności od charakteru działalności podmiotu, specyfiki branży i przyjętej strategii. Utworzona w instytucie

badawczym modelowa Platforma Technologiczna jest narzędziem wspomagającym proces zarządzania wiedzą, a w szczególności proces kodyfikacji wiedzy. Platforma umożliwia zarówno kodyfikację wiedzy o partnerach i realizowanych projektach, jak i gromadzenie wiedzy o innowacyjnych rozwiązaniach technologicznych. Platforma umożliwia dyfuzję wiedzy do gospodarki. Jest jednocześnie podmiotem identyfikacji potrzeb i oczekiwań rynku w zakresie innowacyjnych technologii. Celem artykułu była analiza i prezentacja wykorzystania Platformy Technologicznej jako operacyjnego mechanizmu wykorzystywanego w zarządzaniu wiedzą w procesie komercjalizacji wyników prac B+R prowadzonych w jednostce naukowo-badawczej.