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THE ROLE OF KNOWLEDGE TRANSFER IN THE PROCESS OF IMPLEMENTING NEW PRODUCTS BY COMPANIES

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Summary

The aim of the paper is to show the multi-faceted interactions occurring between the phenomenon of technology transfer and cooperation existing along the knowledge-business axis. Research methods are the theoretical-empirical analysis, complemented with the study of subject literature, including reports and research done by the author. The study of the literature proved the correctness of the hypothesis that the cooperation between scientific units and various businesses is determined by the transfer of knowledge, aimed at implementing innovative solutions. Searching for facilitators and inhibitors in the process of knowledge transfer outside the theoretical domain reveals an enormous practical dimension in updating economic programs, on both the domestic and international level.

Keywords

company • business • science • knowledge transfer • innovation • research and development

1. Introduction

Intellectual potential and knowledge connected with new achievements in the field of science are both key in making decisions in the economy based on knowledge about the development of countries. Small and medium sized companies are attributed with a higher level of implementation of innovation, since they are characterised by a higher flexibility in decision-making, and a less bureaucratic style of management. The process of technology transfer has often been touched upon in the literature on the subject, however, the phenomenon has not been dealt with at length.

This article seeks to show multi-faceted correlations occurring between the phenomenon of technology transfer and cooperation existing along the knowledge-business axis. The main hypothesis has been formulated, stating that the cooperation between scientific units and various businesses is determined by the transfer of knowledge, aimed at implementing innovative solutions. The study of subject was dictated by the urge to identify factors influencing economic growth in countries with medium level of development with respect to the development of technology and implementation of innovations. The scientific intent should allow for further verification whether

Poland possesses a potential enabling it to achieve results in the future which would be at the same level as the innovative leaders in the European Union.

The article has been mostly based on the study of the available literature on the subject. Partial results of the research conducted by the author have also been used to assist with the theoretical-empirical analysis. Interactions occurring between the spheres of science and business have been subjected to analysis by the author within the scope of this work. Conclusions drawn from the above mentioned analyses allowed for the assessment of the advantages and disadvantages of the process of cooperation between scientific units and various businesses. Searching for facilitators and inhibitors in the process of knowledge transfer outside of the theoretical domain reveals an enormous practical dimension in the process of improvement of economic programs, on both the domestic and international level.

2. Transfer of knowledge from a scientific unit to a business

Global economy is a type of economy in which the production factors (technology, natural resources, capital, and labour force) as well as products and services circulate around the world [Stulich 2008, p. 99]. In such conditions of conducting business activities, companies are looking for more advantageous relations for achieving profits, increasing production and improving sales as well as trying to deliver products and services with the highest technical, quality, and performance parameters [Glinkowska and Kaczmarek 2016, p. 7; Włodarczyk 2008, p. 86–98]. The beginning of the 21st century became the time for Polish scientific units to start supporting the development of institutions, which in turn bolstered up businesses and helped scientists adjust to working in a business reality, particularly in the area of experimental sciences (technology transfer centres, technology incubators, etc.) Various businesses are interested in cooperation with scientific centres, either directly or indirectly (through support centres), since commercial results of scientific research help them enrich the resources of their companies [Trzmielak 2013, p. 31]. Therefore, R&D sector, enterprises and institutions intermediating in the technology transfer are entities of mutual interaction [Strużycki and Bojewska 2011, p. 27].

The attitude of economists towards innovation has changed over the last decades [Włodarczyk 2009, p. 15–17]. Initially, what was the most important in these processes, had been the ability to create innovation. Currently, the main point of interest is the development of the ability to absorb technological innovation. Technology transfer is a multi-faceted process, and its effect is the implementation and the spread of technical innovation, also bringing along a new state of knowledge about the means of production [Świadek and Wiśniewska 2015, p. 8–9]. Processes connected with the creation and the transfer of knowledge are becoming increasingly more localised. This means that they are more defined within their respectable geographical spheres, and strictly connected to their specificities. Whereas, the transfer of knowledge between companies is mostly connected with diffusion of innovation. Making an invention available to a business by a scientific unit is to be treated as a vertical transfer. On the other hand,

a diffusion is referred to as a horizontal transfer of technology [Jasiński 2014, p. 29–30]. What occurs on the side of scientific units is passing of the results, while absorbing them takes place on the side of businesses.

The discussion connected with the increase of the effectiveness of science and inventiveness of scientific and research centres began in Poland at the end of the 1990s. [2013, p. 298]. Until then, for many years, Polish science had operated as a complete opposite to the market-driven model. The outcome of the scientific research did not show any characteristics of practical usability, neither for scientific units themselves, nor for the market at large. However, the main quality of the contemporary business model is the supposition of the existence of an actual customer or client who determines the financing of scientific research by a given scientific unit on the basis of obtaining results which are useful for the market, and who devises a plan for the implementation of those results. The scientific business model also involves the ability of effective utilisation of intellectual capital of a scientific unit in order to complete tasks which are practically useful. Unfortunately, many researchers unequivocally indicate that cooperation between science and business is insufficient, which further results in a low level of implemented innovation in the Polish economy [Trzmielak, Grzegorczyk and Gregor 2016, p. 7]. The current situation is well illustrated by the decrease in the innovation rating, in comparison with the previous year. According to the *European Innovation Scoreboard 2017* (KE 2017), Poland moved two places down, from 23rd to 25th position on the list.

A new type of relations with the environment is included in the model of the entrepreneurial university, also called the university of the third generation. It breaks with the separation of a university from the needs of an economy and a society. The aim of a university, apart from educating future scientists, is currently the promotion of entrepreneurship and innovation. According to the findings of the research conducted at the Institute for Private Enterprise and Democracy, the cooperation between science and business in Poland focuses on relatively simple forms, such as on-going consultancy and expert evaluation [Piotrkowska-Piątek 2016]. The improvement of the status quo depends on the ability to identify the determinants, the facilitators, and the barriers existing in the process of cooperation between the two spheres. The determinants entail internal factors (as they depend on scientific institutions and businesses) as well as external ones (such as legal regulations, and principles of financing R&D operations.)

Despite the aforementioned advantages, the transfer model from highly developed countries and its implementation in the Polish reality might be risky, and it may sometimes stir up controversy. The emphasis on commercialisation of scientific knowledge might be the result of a top-down economic doctrine, and therefore, attempts to connect scientific units with economy have a political character. Moreover, profits from commercialisation are mainly experienced by the private sector, and not by the higher education [Nowak and Gliściński 2016]. It is important to mention that under the pretences of cooperation with the business, and considering the political discourse aimed at bringing legal solutions giving private businesses easier access to patents, the situation might result in a problem of the surplus of patents [Guzera 2012]. Paradoxically, the outcome might

be a decrease in financing of R&D, and an increase in expenses devoted to legal service of patents and their acquisition. Owning patented technologies might result in the blockage of sales of products of one's competition. In this case, that which counts is the quantity, and not the quality of innovations and new solutions.

3. Scientific knowledge in economic practice

21st century is the beginning of an era of dynamically developing, new, innovative products. New branch of technological businesses such as bioinformatics or nanotechnology are mostly interdisciplinary, and they require complex knowledge. Knowledge is the element that might provide competitive advantage, enabling development of businesses, and ultimately it plays an important role in the economic growth and transformation towards modern knowledge-based economy [Matusiak 2010, p. 77]. This competitive potential may determine the capacity of enterprises to survive the next economic recession, and to build a competitive position in the post-recession period [Dzikowska, Gorynia and Jankowska 2016, p. 291]. The receptive side in the process of knowledge transfer is often a small or medium business enterprise (from the Polish "MSP" meaning SME sector of small and medium enterprises), a company that is interested in the effects of implementation of innovation. On the other hand, since big companies usually have their own Research and Development Departments employing scientists in their own organisational structures, in such cases the transfer of knowledge has an internal character. Moreover, scientists employed in these departments, due to low remuneration, do not belong to the most highly qualified in the field, and therefore it is difficult to find experts among them that would specialise in the area of implementation. Summing up, it is important to assert that the MSP sector should be supported by the appropriate market mechanisms, when it comes to fundraising and implementation. Transfer of technology, especially for small and medium enterprises, seems to be a complex and time-consuming process, which can bring the desired effects when given the support needed.

Transfer of knowledge between science and economy takes place when developing a concrete, specific innovation, but only when the party that is commissioning the new solution, and the party that is accepting it both arrive at the conclusion that it will produce the result that is feasible to implement in the business context, and at the same time that will be satisfactory to both sides. The effectiveness of the transfer does not solely depend on the willingness of the commissioning side or the contractor, but also on many other interrelated factors. New technology cannot remain on its initial level, but it must be constantly adjusted to the needs of recipients on the ever changing, competitive, international market. Among the most well-known tools applied by scientists and entrepreneurs are: implementation of cooperative research and development projects, especially those co-financed by the European Union and Poland, as well as the creation of various businesses through their emergence from the parent units, mainly from educational institutions whose goal is to commercialise scientific knowledge and technology (Table 1).

Table 1. Factors determining the establishment of R&D business by a company (% of recommendations)

Shortening of the time of product development – when launching a new product, one cannot count on the fact that it will have a long lifespan (the time before it becomes obsolete), which enforces a constant implementation of innovation in order to stay on top of the market game.	52.78%
Swiftly changing technology – enriching one's products with new functions and possibilities. Clients do not buy technological solutions for the sake of sheer solutions, but as an answer to or an improvement of existing issues.	30.56%
Globalisation – the number of companies competing on the global market has significantly increased. Most new products are created on the basis of the ones already existing on the market.	16.67%

Source: on the basis of author's own research

In order to prove the significance of the factors that determine the flow of knowledge from science to business, the author used his own research in which a group of 96 small or medium enterprises from the entire area of Poland were chosen as a research sample. 36 of them filled in and submitted a questionnaire. The research findings indicate that the main reason why they undertake innovative actions is trying to avoid shortening of the lifespan of a product; on the other hand, the lowest number of companies quoted globalisation as a reason. This might derive from the fact that businesses concentrate on factors, which directly touch them, not anticipating any threats in macro-factors, in this case in the process of globalisation of the economy (Table 2).

Table 2. Most advantageous strategy of commercialisation of technology by research units and universities conducted in the conditions of an economic crisis, according to SMEs (small and medium business sector) (% of recommendations)

Licensing an invention to a big corporation	36.11%
Licensing an invention to a start-up company	33.33%
Selling an invention to a third party	30.56%

Source: on the basis of author's own research

The research regarding companies was also conducted in a potential crisis situation. Companies claimed that it is comparatively profitable to sell an invention to a third party, licence it to a start-up company, or to a big corporation. An interesting conclusion may be drawn on the basis of the difference in the answers given by companies associated with a more traditional profile, which most often chose licensing an invention to a start-up company as the best option (10 companies), secondly to a big corporation (7 companies), and as the least popular option they chose selling the invention (3 companies). When it comes to high-tech companies, the option that dominates is

the one where an invention is sold to a third party (8 companies), followed by licensing to a big corporation (6 companies). Companies connected with advanced technologies do not consider licensing an invention to a start-up company as advantageous (2 companies), typically regarding such method of commercialisation as the most risky.

When drawing further conclusions, what must be taken into consideration is limited representation of companies, which took part in the research. The process concerning the transfer of knowledge as such requires a separate, wider-scope research that would include: an attempt at establishing the role of the culture of innovation in companies and in research centres; the management of innovations; the creation of a network of innovations including institutions from both the regional market and the international one; the protection of intellectual property rights; as well as the financing of the entire process. The topic of the transfer of knowledge to economic practices is to a large extent dependant on an educational offer, through appropriately developed curricula, an exchange of employees between various academic centres and businesses, as well as connecting educational institutions to research centres and to different businesses. Further research will also require the creation of indicators enabling the determination of the demand for training and consultancy services among representatives of scientific units wanting to participate in the process of technology transfer.

4. Significance of the interaction between science and business in the process of knowledge transfer

The complexity of relations between science and business derives from, among others, separate objectives and motivations for action, different organisational cultures, as well as varying structures and communication styles [Duda 2009, p. 30]. Universities that are most successful in terms of knowledge transfer, for example Stanford University, do not treat commercialisation as a secondary function. Apart from maintaining a high level of education and research, they prioritise entrepreneurship and the process of the transfer of knowledge and technology to industry. One of the popular concepts of the cooperation between science and business is the Triple Helix Model, which adopts the paradigm of the developments of innovation through making use of relations between governing bodies, production sector, as well as scientific and technological departments. Other models are based on creativity, capital, network relations, or sponsored cooperation [Trzmielak, Grzegorczyk and Gregor 2016, p. 133–134].

The size of the given company directly influences the possibility of cooperation with a research centre, and the implementation of new technologies. Cooperation with research centres seems more typical of those companies with a higher ability to absorb knowledge as well as those conducting their own, in-house research. The subject of interest for these companies is most of all the introduction of radical innovations that are able to change the order, which has existed on the market up to that point. They are often characterised through so-called creative dysfunction [Kornai 2014], when companies with cutting-edge innovations threaten the market with a new product belonging to their primary business. A good example here might be KODAK, the

company that eliminated old film cameras from the marked. A hurdle in cooperation is the lack of innovation culture that requires not only the willingness, but also a certain type of a code of conduct [Czerniak 2013, p. 267–271]. Some research on companies also indicates that despite possessing certain financial means, companies do not recognize the need to invest in the development of their employees [Jasiński 2016, p. 68].

Currently only few researchers cooperate with the industry. This cooperation is often taking place within the framework of various research projects, financed by different European institutions. Engaging in common research projects is also associated with additional income. Furthermore, all knowledge regarding the implementation of various projects and technological issues acquired by a company might provide a great stimulus for conducting further research, concerning future solutions. With respect to the hypothesis claiming that there is a need for an improvement of cooperation between science and business, conclusions have been organised into a chart listing problems and suggested solutions on the basis of conducted research (Table 3).

Table 3. Cooperation between science and business. Problems and suggested solutions

A problem/a hurdle	Suggested solution
1. Scientists do not possess practical experience in cooperation with business entities; there is a lack of skills required for commercialising the developed technologies	Promoting common research projects; training programs; popularisation of new professions such as innovation broker; business fairs aimed at networking
2. Scientific language which is unintelligible for an average entrepreneur; a "scientist mentality" (research as an aim in itself)	Institutions serving as mediators in communication between science and business; lectures common for entrepreneurs and scientists; implementation of a diploma system and a doctoral system aimed at solving particular problems existing in the industry
3. Bureaucracy in scientific units; legislation misaligned to the needs	Improvement of administrative procedures, for example reducing the amount of documentation required in projects; clear rules and procedures regarding intellectual property
4. Risk of success in research and development projects; no financial means or their ineffective use	Creating new scientific service centres and improving the existing ones; practical use of research findings; change of financing sources from public to private
5. Lack of knowledge in the area of cooperation with scientific units or too much information on the subject	Specific databases and offers of cooperation; participation of mass media in the promotion
6. Lack of motivation for cooperation between science and business	A system of points promoting cooperation with the industry; grants for risky research projects involving small and medium enterprises; comprehensible rules regarding accounting for the means as well as changes in qualification handbooks

Source: own elaboration

Finding common advantages is the necessary condition for the existence of cooperation between a company and a scientific partner, which does not seem to be easy to achieve since both sides clearly differ in that respect. Cooperation between higher education and industry will be effective and advantageous for both parties only if the individual interests of each party are protected from the very beginning. On the one hand, they should be legally protected against technological risk, on the other hand, they should be covered by intellectual property law protecting the scientists. What may be noticed in the relation between academic science and business is a clear lack of mutual trust, a difference in the way of thinking, and most of all, on the side of the business, enormous scepticism regarding practical effectiveness of institutionalised science.

5. Conclusions and recommendations

The findings of the conducted research showed some hurdles limiting the scale of innovations in Polish economy as well as some factors stimulating innovative processes. Transfer of knowledge and new technologies from the sphere of science to business context is one of the main factors contributing to the increase in innovation and competitiveness in economy today. The biggest hurdle in cooperation between science and business is the domination of overly demanding attitudes. A breakthrough in innovation cannot be achieved without any changes in the attitude and the culture of societies. Innovation has its source in society, education, and the ability to collaborate. In order to improve the current situation, it is necessary to strengthen the position of those university departments responsible for transfer of knowledge, and to create conditions attracting specialised staff including experts in the area of communication. What is necessary is the creation of a professional strategy regarding the development of marketing abilities, negotiation skills, and technical expertise that is key in the transfer of knowledge.

What we can expect to take place in the future is a significant increase in the interest of scientific units in research activity, and within it, also in the cooperation with businesses. A decrease in the number of students due to population decline compels decision-makers to look at priorities regarding the activity of various units from a different point of view, but it also urges us to conduct further research into the topic of knowledge transfer, and in particular the one that seeks to find factors determining such transfer specific to a given region. The implementation of change in the algorithms regarding financing of scientific units from State budget should foster the process of activating universities in the field of scientific research, and their cooperation with businesses that should bring about the development of both sides, but also as a result the overall development of particular regions and countries.

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