The Relationships in the Process of Knowledge Transfer According to the Triple Helix Model

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Abstract

One of the most important challenges facing modern scientific entities is network cooperation with other organizations and a dialogue facilitating their access to information and knowledge. The essence of this relationship is well illustrated by the Triple Helix Model, which refers to network cooperation in the process of creating knowledge between the academic sector, industry and government. The aim of the study is to analyse and evaluate the relationships in the process of knowledge transfer between the academic sector and other entities working for knowledge-based economy according to the Triple Helix Model. To achieve the purpose of the work, the author used desk research and empirical research. The empirical part of the paper is a case study describing the project called V4mula, as well as conclusions from the realized qualitative research (diagnostic survey method). Project V4mula was mplemented in the network of four partners operating in the Visegrad Group.

Keywords: knowledge transfer, network cooperation, innovative processes, Triple Helix Model

1. Introduction

An important distinguishing feature of innovative and competitive organizations is, among others, the demand for knowledge and willingness to cooperate, reflected in the development of various types of bilateral and multi-sector partnerships as well as networks. In the 21st century, different types of networks almost dominated social and economic relations. It could be argued that the spirit of our time is the spirit of the network (Barney, 2008). The network is a set of measures and rules that allows entities to have access to them, making an implementation of joint projects (Brilman, 2002). Networks consist of nodes, links, and flows. Links combine nodes between which there are flows. Nodes, links, and flows in networks are determined by many variables that shape the network of character and shape (Barney, 2008). A network embodies a set of relationships between different entities having the same interests (Hopej, 2013). It is sometimes referred to as a set of autonomous organizations with direct or indirect relationships arising from the agreements (alliances) between participants (Pachura, 2009).

Networking plays a key role in today's knowledge-based economy, oriented towards innovation, and above all towards smart, sustainable growth. It can be said that the spread of the network has fundamentally affected the functioning and performance of many processes: production, experience building, power and culture (Castells, 2007), and ultimately enhances the development of the knowledge economy.

Smart, sustainable and inclusive growth is the key goal of several EU initiatives, strategies and programmes in the short, medium and long term and at the regional, national and pan-European levels (Carayannis, Rakhmatullin, 2014). There are many mechanisms supporting network collaboration, created both in the networks themselves and in their surroundings. Network economy is characterized by increasing the number of links between organizations, based on the synergistic benefits and optimization of use of available resources (Borowicz, Dzierżanowski, Fisherman, Szultka, 2009). These organizations, while pursuing their own goals, are also part of the knowledge transfer process, contributing to the creation of technological and social innovations.

Networking is currently being implemented in many different models and at different levels, although new concepts for its development are still emerging. More and more networks are global. In addition, they often include a large group of diverse entities, which require efficient communication between network participants and efficient management of the relationship between them. Models and tools that aid these processes these processes are helpful here, primarily in terms of production and knowledge sharing, enabling innovation. Terms of rationalization of organization and management of network ventures, focusing on mutual flows of knowledge and innovation between different spheres, were presented, among others, in the

concept of the Triple Helix Model. It describes the key conditions for the development of networking between organizations, linked through networking, as well as identifies factors that enhance networking processes, primarily as regards the flow of knowledge and innovation between network participants. Using these models also dynamically shapes and develops the structure of the network, and also contributes to the efficiency of the implemented activities.

Networks for exchanging knowledge about socio-economic processes are also developed by organizations cooperating within the Visegrad Group (Poland, the Czech Republic, Slovakia, Hungary), which implement partner projects on various topics. The Triple Helix Model assumptions were used to improve the emerging knowledge transfer network for innovative processes within the framework of the project. V4mula, subsidized by the Visegrad Fund (no. 21520396), implemented in the years 2015-2016 in the cross-sectorial partnership of the organization: INNOSKART Nonprofit Ltd. (cluster - Hungary), University of Dąbrowa Górnicza (High education institution, Poland), You too in IT – non-governmental organization, Slovakia) and DEX Innovation Center (company, the Czech Republic). This paper presents the case study of this project as well as the results of questionnaire surveys, which were attended by representatives of the organizations that make up this network (30 respondents), from the academic, public and business sectors. The aim of the study is to analyse the relationship between the academic sector and other entities involved in sustainable development in line with the Triple Helix Model assumptions. This paper can be useful for all organizations that work in networks, especially for those that emphasize knowledge management and boost innovation.

2. Network cooperation and the Triple Helix Model - theoretical background

The Europe 2020 Strategy raises challenges for the European Union countries relating to i.a. intelligent growth, linked to the development of a knowledge- and innovation-based economy, creating high added value, requiring substantial expenditure on R & D and rapid transfer of theoretical knowledge to business practice. Since the knowledge-based economy cannot develop without an educated society, the quality of education and the development of skills and competences are becoming increasingly important. This applies to the public, commercial and academic sectors. Each has its own contribution to the development of a knowledge-based economy, although the synergistic effect of their networking can outweigh the effects of individual actions.

Contemporary networks are focused on developing innovation models based on knowledge transfer between collaborating organizations. It is evident that in the economy of the 21st century, knowledge and the inextricably linked human capital shape the innovative activity of many organizations, and thus have an impact on the creation of innovation. The organizations which skilfully use their own knowledge and external expertise, invest in research and development as well as develop relationships with partners, develop dynamically and create a high added value in the economy. Among such organizations there is a noticeable increase in the number of cooperative and network links of various character and various degrees of durability. These relationships can take the form of partnership and network projects with a fixed implementation horizon and can be long-term and sustainable. The dynamics of network collaboration requires a deepening of the organization's knowledge about how to manage networks and relationships in networks. It is important to achieve the goals that the network seeks to achieve, as well as to ensure its sustainability, efficiency, effectiveness and achievement of expected results. Managing relationships in the network includes appropriate selection of cooperating entities, defining the forms of cooperation or methods of communication. Optimization of models and forms of cooperation in networks becomes a challenge for the organizations involved, primarily in terms of assessing the effectiveness of the resources and potentials involved and the results achieved.

At present, innovative processes are most often carried out in a specific system of relations between enterprises and their business environment, with the involvement of research and non-governmental institutions and the public administration. It is clearly visible that the dynamics of the creation and development of commercial innovations are interdependent on the efficiency of the public and non-governmental sectors. In innovative processes, complex cross-sectorial ventures are beginning to dominate, with the involvement of many organizations which gradually displacing individual projects. This requires active involvement and development of network links from the organisations engaged in the cooperation. The Triple Helix Model (Leydesdorff, Etzkowitz, 2010), the Quadruple Helix Model, and the Quintuple Helix Model (Carayannis, Campbell, 2011), depending on the objectives of the cooperation, the organizations involved, can be identified as examples of cross-sector interconnections.

The Triple Helix Model focuses on university–industry–government relations. The Quadruple Helix Model contributes to these relations also the media-based and culture-based public as well as that of a civil society. Features of the quadruple

helix are: culture (cultures) and innovation culture (innovation cultures); the knowledge of culture and the culture of knowledge; values and lifestyles; multiculturalism, multiculture, and creativity; media; arts and arts universities; and multi-level innovation systems (local, national, global), with universities of the sciences, but also universities of the arts. The quadruple helix contextualizes the triple helix, and the quintuple helix the quadruple helix (Carayannis, Campbell, 2011). The Quintuple Helix Model emphasizes the natural environments of society, also for the knowledge production and innovation. It is ecologically sensitive (Carayannis, Thorsten, Campbell, 2012). Each of the models mentioned above takes into account the different aspects of network collaboration, but in view of the objectives of this paper, the Triple Helix Model should be focused on in a particular way. It is related to the concept of a knowledge-based economy (Carayannis, Barth, Campbell, 2012) and it is relevant to the relationship between the academic and other stakeholders communities, i.a. engaged in the V4mula project implementation. The highlight of this project is, among others, the planned outcome of the partial change of roles of individual organizations and greater engagement in activities traditionally attributed to another sector.

The Triple Helix Model, i.e. university-industry-administration-based model (Leydesdorff, 2014), can be helpful in explaining structural change in knowledge-based economies. In this model, innovation is created through the process of creating and transferring knowledge as a result of the interaction between three types of entities: research units (universities and research and development centres), industry (enterprises) and the governmental sphere, e.g., entities shaping country development policy (government, council, administration).

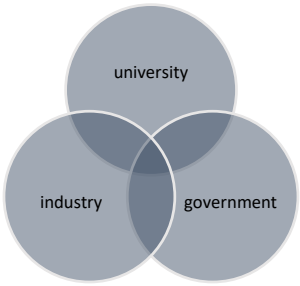

Fig. 1. Triple Helix Model

The Triple Helix Model is a reference to at least three key issues related to network collaboration. Firstly, it shows the specific, knowledge-based configuration of university-business-administration relationships. Secondly, it emphasizes the social aspect of building relationships between these three groups of entities, since in each case people are engaged in these activities. Thirdly, the participatory aspects are also included in the relations between the spheres of science, business and administration, i.e. public debates, public consultations and research which accompany the innovation processes. Under certain conditions, a system of overlapping communication between the sphere of science, business and administration can function as an independent organization, e.g. in the form of a cluster.

The Triple Helix Model is based on a nonlinear model that replaces linear models based on 'market pull' or 'technology push' approaches (Leydesdorff, 2014) and enables the analysis of potential synergies, nonlinear interactions between the three helices. The cooperation network expands as science, industry and administration become more involved in the promotion of economic development and research (Bojar, Machnik-Słomka, 2014). The essence of the model is the dependence, according to which what is happening in each helix and in the relationship between them, becomes visible in the functioning of the socio-economic system in which the network operates. As a result of network co-operation; however, it is becoming more and more frequent to change roles. Potentially, each of the triple helix elements can play a different role, e.g. an organization from the sphere of industry can develop research and development in its own laboratories, which is why it takes on the role of the entities in the sphere of science while the university develops academic entrepreneurship in the sphere of business. The centre of power can perform academic functions, supporting the academic research system and developing educational activities targeted at entrepreneurs. Networking in the triple helix model strengthens links between organizations, leaving them autonomous.

Analysis of knowledge expansion proves that the existence of cooperation within the three sectors is not a sufficient condition for innovation. The nature of the dominant industry (Leydesdorff, Fritsch, 2006) plays a significant role, but the

importance of the university is also visible (Marques, Caraça, Diz, 2006) and, in particular, academic entrepreneurship (Lawton Smith, Ho 2006, Tijssen, 2006). Case studies related to undertakings implemented in this type of network confirm that this model also provides opportunities for promoting innovation and building partnerships (Johnson, 2008). Some authors also point to the presence in this model of indirect organizations located in the space between the sphere of science, business, administration (Olechnicka, Płoszaj, 2010) such as: spin-off companies, incubators and technology parks, patent attorneys offices, scientific networks, etc. (Etzkowitz, Leydesdorff, 1998).

3. Method

The aim of the study is to analyse the relationship between the academic sector and other network participants in line with the Triple Helix Model, in terms of factors influencing the flow of knowledge and the results of this process. Scientific discussions were conducted by the example of cross-sectorial network project called V4mula, implemented by organizations from Visegrad Group countries (V4), with funding from the Visegrad Fund. The project has focused on the promotion of international Research&Development&Innovation (R&D&I) cooperation between the interested organizations. The partners have the opportunity to improve their knowledge and experiences, exchange good and bad practices, promote new technologies and support each other in building new technologies. The scope of the project was the implementation of a joint program for Responsible Research and Innovation (RRI) in V4 regions.

The objectives of the paper are:

1. Evaluation of factors affecting the knowledge flow between the sectors defined in the Triple Helix Model, divided into groups of factors that characterize:

a) knowledge transfer,
b) the behaviour of network operators on their participation in the knowledge transfer process,
c) sectors involved in the transfer, i.e. science, business, administration,
d) major addressees of innovation i.e. society,
e) network environment.

2. Assessment of the relevance of knowledge transfer results between the sectors participating in the Triple Helix Model, from the innovation point of view which is the effect of the network functioning.

To achieve the purpose of the work, the author used research and empirical research. The research work is primarily an analysis of available literature and other materials related to networking and knowledge transfer. The conclusions of these studies are described in the previous chapter.

The empirical part of the paper is a case study describing the project called V4mula, as well as conclusions from the realized qualitative research. The research covered 30 organizations including: 10 from Poland, 6 from the Czech Republic, 4 from Slovakia and 10 from Hungary who joined the network. Each was represented in the survey by one respondent, including 12 academics, 6 business representatives, 8 non-governmental organizations, and 4 representatives from government and local government. Most respondents (18) declared that they were very much involved in networking at international level, 8 reported that their engagement was mediocre, and 4 respondents stated that their engagement was low.

The study was conducted in 2017, using the diagnostic survey method, in written and electronic form. The survey questionnaire concerned, among others, three research problems below.

The first of them was an assessment of the importance of each sector, i.e. science, business and administration, in the process of creating knowledge-based innovation. In addition, the influence of social capital, which is included in the Quadruple Helix Model and the Quintuple Helix Model, is also taken into account. Due to the fact that people as consumers of innovation drive progress in many areas, thereby contributing to the dynamics of knowledge transfer and innovation creation, this factor was also supported in the combination of sectors presented clustered in the Triple Helix Model. The described factors were evaluated on the scale of: weak, average and significant influence on the process of creation of knowledge-based innovations. In particular, it was about how the relationship between the academic sector and the other sectors is shaping the impact on the process of creating knowledge-based innovation.

The second research problem was related to the factors that affect the flow of knowledge between the sectors defined in the Triple Helix Model. These factors were evaluated by the aforementioned groups (a-e). A total of 25 factors were

evaluated on a scale of: 0 - no impact; 1 - very weak influence; 2 - weak influence; 3 - average influence; 4 - strong influence; 5 - very powerful influence. In the process of analysing these factors, it was sought to identify a group of key determinants (taking into account the highest average rating) responsible for knowledge transfer across the network.

The last of the analysed research problems concerned the results of the knowledge transfer process between network participants, aiming at innovation. A set of 9 potential outcomes of broadly understood innovation processes was tested. The respondents were asked to evaluate the relevance of these results from the point of view of enhancing the innovation of organizations participating in the network.

The solution to the research problem was based on the use of the research methods described above, including the observations of the author who participated in the implementation of the project.

4. Case study – V4mula project

The project named V4mula, co-financed by the Visegrad Fund, was implemented between 2015 and 2016 in a cross-sectorial partnership of four organizations: INNOSKART Nonprofit Ltd. (cluster - Hungary), University of Dąbrowa Górnicza (high education institution, Poland), You too in IT (non-governmental organization, Slovakia) and DEX Innovation Centre (company, the Czech Republic). INNOSKART is the only Silver Labelled cluster in V4 and South East regions with high experience in innovation driven business development. DEX IC is an innovation centre and has supported innovations and technology transfer as external expert in many projects. University of Dąbrowa Górnicza runs many innovative network projects such as: WSB Science Academy, Science Festivals, training projects addressed to the social groups, School of Leaders, Youth Academy of Media, E-Teacher Academy, etc. You too in IT runs projects for high school to motivate students for ICT, it organizes big events and is responsible for communication among partners creating networking.

The reason to develop the project was the socio-economic situation of the Central Europe countries and regions, also V4 countries. They are still behind the leading European regions according to the ranking by GDP (Statistic times, 2015) and also according to the ranking by Global Innovation Index. Most of the entities from V4 did not succeed in participations in innovation projects like Horizon 2020 and very often they do not have strong connections with the innovators, the intellectual workers or the scientists dealing with the top current research. In this case there was a need to decrease these gaps by Responsible Research and Innovation (RRI) development for global networking, especially for the needs of V4 civil- and innovation entities.

The consortium was represented by businesses network, a university, an innovation expert and civil association. Due to the wide range of connections the partners have, the primary target groups were: SMEs and researchers, non-governmental organizations and public authorities, citizens as 'end-users' ready for further cooperation. The secondary target groups were young people developing their career paths based on knowledge and innovations in different sectors.

The project was designed to develop the regional economy by improving the networking between the civil and business sector. The added value of the project was an excellent strengthening of the partnership and increased trust between the cooperating organizations. The main topics were:

a) Triple helix, Quadriple helix and Quintuple helix models concerning knowledge drivers and innovation drivers,
b) networking and clustering in V4 countries,
c) RRI,
d) social engagement.

The final activity was the workshop focusing on the networking among the regional participants and V4mula partners. Generally, the speakers were regional experts of the dedicated topics; the participants were regional entities interested in innovation-oriented networking.

The project was focused on the promotion of international R&D&I cooperation and knowledge transfer between partners within the network. The interested entities have the opportunity to improve knowledge & experiences (through trainings), exchange good and bad practices (through workshops), promote new technologies (through exhibitions) and support each other in building new cooperation among the civil- and innovation entities towards the global networking (during the final conference and after the formal completion of the project). The scope of this project was the implementation of a joint program for RRI in V4 regions.

The program developed the national economy by encouraging RRI via global networking. The high quality of the consortium was assured by the partners' excellence derived from different fields of business and economy development. The partners represented knowledge and experience on: HR developments (PL), Civil society and Networking (SK), RRI (CR), business developments (HU). Partners were dedicated to improve their knowledge in parallel with supporting their regional economy development, intensely focusing on innovation and networking.

The project's aim was to improve the V4 regions' competitiveness via: special training program on Triple helix, Quadriple helix and Quintuple helix, regional workshops, international conference and exhibition. The outputs were: 4 regional workshops (1 by each partner in home regions where all the partners presented and added their knowledge and expertise to the program by their personal presence), 4 trainings (1 by each partner in their home region with local experts in a native language with the main focus on 'Science with and for Society' aspect), 1 international conference where all the gained knowledge and related experiences were shared. The additional direct output was the encouraged global networking. Another activity was the 1 exhibition to promote new technologies of V4 regions, 1 Linkedin Group and 1 web- and 1 Facebook appearance led as well as 1 video film on YouTube channel.

The direct results achieved by the end of the project are as follows: the knowledge and experience on RRI has been improved; the networking between the civil- and innovation entities have become more effective; the European visibility of V4 partners has improved. In totally, ca. 100 people participated in all the activities within the project.

The further network development after the project completion is based on the area of technology, innovation and entrepreneurship. Technology, innovation and entrepreneurship are the driving forces behind the development of a knowledge-based society. The sustainable development of such a society can only take place when knowledge is produced and promoted and when innovation is developed.

After the project, the partners' ability for generating and participating in new consortia has improved. The four major pillars of the partners' activities after the project are: exchange new knowledge and experiences (emails, Skype conferences), share business ideas and find synergy that creates new business models, marketing plans or products (Face-to-Face meetings), commercialization (business driven networking) and global networking.

5. Results

To determine the relationship between the academic sector and other sectors in accordance with the Triple Helix Model, respondents were asked about the impact of individual sectors on knowledge flows and innovation. The respondents were also expected to assess the role of society as a consumer of innovation, and at the same time the source of inspiration for their creation. According to research, the greatest influence on the transfer of knowledge and creation of innovation was clearly assigned to the business sector (21 persons, 70% of the respondents), followed by the academic sector (6 persons, 20 %) and the administration sector (3 persons, 10 %). At the same time, only 40% of the respondents (12 persons) felt that society has a significant impact on innovation. It should be noted that the respondents in this question referred mainly to their own experiences (all network participants declared a link with innovative processes), since the duration of the cooperation network within the project was not long enough for such relations to become expressive. As for the assessment of factors affecting the flow of knowledge between the sectors defined in the Triple Helix Model - the respondents' ratings of the groups were presented below.

In the first place, the factors related to knowledge transfer were analysed. It can be assumed that knowledge as an organization resource and as a product that can be the subject of a business transaction must be characterized by certain characteristics. This applies both to knowledge that is transferred from the academic sector to the business sector (primarily knowledge acquired through fundamental research, know-how and inventions), as well as knowledge transferred from the business sector to the academic sector (e.g. knowledge of the demand for technological and social solutions to fill the identified market gap or knowledge about the specific needs and expectations of customers). The following table shows the assessment of these factors by the respondents.

Tab. 1 Transferred knowledge

Nº	The type of factor	Rating
1.	The quality of knowledge	4.07
2.	Availability of knowledge	4.36

3.	Price of knowledge	3.86
4.	Usefulness of knowledge	4.28
Average:		**4.14**

Source: survey results

In the five-level scale the transferred knowledge was rated high, at an average of 4.14 points. Relatively highest was graded the availability of knowledge (4.36) and the lowest – the price of knowledge (3.86). It should be noted, however, that among all the groups of factors assessed, the transferred knowledge, more specifically its quality, availability, price and usefulness, was identified by respondents as a key factor influencing the flow of knowledge between the sectors defined in the Triple Helix Model.

The study also assessed the behaviour of network entities on their participation in the knowledge transfer process. In this case, 11 factors were analysed. Their selection was based on observing the behaviour of the participants of the network during the implementation of the tasks envisaged in the project. Assessments of the individual factors are included in the table below.

Tab. 2 Behaviour of entities in the network

Nº	The type of factor	Rating
1	Participation in networks for knowledge and innovation transfer	3.86
2.	The need for external knowledge, those from other sectors	3.64
3.	The tendency for sharing knowledge	3.36
4.	Ability to evaluate and use knowledge	3.57
5.	Tendency to implement innovations	3.77
6.	Access to the intellectual workers	3.36
7.	Familiarity with the processes of knowledge management	3.00
8.	Having leaders in organizations/sectors	3.36
9.	Possession by entities from the sector of individual knowledge and innovation management strategy.	2.93
10.	Participatory approach to decision-making process in organizations and sectors	3.00
11.	The tendency to worker mobility between sectors	3.50
Average:		**3.40**

Source: survey results

In terms of the flow of knowledge between the sectors defined in the Triple Helix Model, the behaviour of participants in the network was assessed to be significantly less important than knowledge itself. The average rating of these factors in a 5-step scale was only 3.4. As for individual assessments of particular factors, the highest were: participation in networks for knowledge and innovation transfer (3.86); tendency to implement innovations (3.77); the need for external knowledge from other sectors (3.64). A high score of 3.57 was also obtained by the ability to evaluate and use knowledge. In this group of factors, the lowest possible rating took possession by entities from the sector of individual knowledge and innovation management strategy (2.93). It is clear, therefore, that among factors that are beneficial to the flow of knowledge across sectors are, first of all, the high probability of contact with this knowledge through participation in networks, as well as the identified need for external knowledge that can be gained through participation in the network. For the success of the knowledge transfer process, the respondents' ability to implement innovations based on skilfully applied knowledge is also required.

From the point of view of the sectors participating in the transfer of knowledge, i.e. science, business, administration, the key importance for the respondents is the need for cooperation between different sectors (average score of 3.65), since without realizing the need for cooperation resulting from the desire to achieve specific goals (e.g. access to external knowledge), it is difficult to talk about the success of the knowledge transfer process. The importance of the situation in the sectors, in terms of impact on knowledge transfer, was estimated on average at 3.5. Thus, it was considered that this factor is more important than the behaviour of individual entities functioning in the network.

Tab. 3 Sectors involved in knowledge transfer

Nº	The type of factor	Rating
1.	The need for cooperation between different sectors	3.64

2.	The intensity of the phenomena of competition in particular sectors	3.50
3.	The intensity of the phenomena of competition between sectors	3.36
4.	The level of innovation culture in the sector	3.50
Average:		**3.50**

Source: survey results

The relatively lowest impact on the transfer of knowledge between sectors was attributed to the public as an addressee of innovation (average score of 3.07) and network environment (average score of 3.00). Detailed evaluation of factors is presented in the tables below.

Tab. 4 The main target audience for innovation, that is society

Nº	The type of factor	Rating
1.	Social changes	3.07
2.	Level of society openness to change	3.00
3.	The willingness of society to absorb innovations	3.14
4.	The quality of intellectual capital	3.57
5.	The type of national culture (e.g. Conservatives. Liberals)	2.29
6.	Entrenched in the values of our society	2.64
7.	The ability to learn	3.79
Average:		**3.07**

Source: survey results

The ability to learn (3.79) and the quality of intellectual capital (3.57) were the most important factors that characterize society as the recipient of innovation. These two elements are closely linked to the absorption of knowledge by the society as a consumer, for example, the realization of new needs, promotion of new solutions. A society consciously using available knowledge also has a high ability to articulate needs and expectations which can become a driving force for further innovation. Furthermore, smart society through participatory processes can also be actively involved in the process of creating innovation (e.g. by participating in market research and experimental projects). Society is one of the elements of the network environment, but many other factors also affect the transfer of knowledge, which are evaluated in the table below.

Tab. 5 Environmental factors

Nº	The type of factor	Rating
1.	Provisions of the law favoring the protection of intellectual property	2.77
2.	The availability of funds for financing the process for knowledge transfer	3.21
3.	Provisions of the law	3.07
4.	Turbulent environment	2.93
5.	Changes in the level of technology available on the market	3.38
6.	Changes in the natural environment	2.86
7.	Political changes	2.29
8.	The promotion of scientific research results	3.54
Average:		**3.00**

Source: survey results

Among the environmental factors most rated was: the promotion of scientific research results (3.54). changes in the level of technology available on the market (3.38) and the availability of funds for financing the process for knowledge transfer (3.21). All of these factors have a clear, objective influence on the knowledge transfer process: the first of them improves access to research results for organizations interested in using them. The second refers to technological development, conditioning the need for further innovations while the third takes financial aspects into account, which are necessary for the implementation of innovative processes, often associated with the need to acquire knowledge for a fee. Such transactions usually occur between the academic sector and the business sector or within the business sector.

The final element of the study was to assess the relevance of the knowledge transfer results between the sectors included in the Triple Helix Model. From the point of view of innovation resulting from the operation of the network, 9 factors were

assessed which illustrate the achievable results of knowledge transfer, leading to innovation and its absorption by the market.

Table 6. The importance of the results of the process of the transfer of knowledge between the sectors from the perspective of innovation.

Nº	Name of the result	Rating
1.	High skilled human capital	3.93
2.	Sustainable values and ideas	3.43
3.	High quality economy, new kind of free market economy, new jobs and growth	4.00
4.	Protecting of the natural environment	3.36
5.	New know-how and technology	4.07
6.	New lifestyle and new quality of life	3.57
7.	Participation of citizens in different processes	3.00
8.	New solutions. programs and laws	3.50
9.	Stronger cooperation between sectors	3.86

Source: survey results

Network participants as the most important result of the knowledge transfer process indicated both microeconomic effects, i.e. the new know-how and technology (4.07), as well as macroeconomic effects i.e. high quality economy, new kind of free market economy, new jobs and growth (4.00). Very high skilled human capital (3.93) was also indicated as a very important result which plays an important role in developing the capacity of the society to create innovations in the long run. The least significant result was the participation of citizens in different processes (3.00). It should be noted, however, that the potential results of knowledge transfer processes between sectors were rated by respondents at a similar level (on average 3-4 points).

6. Conclusion

In order to determine the relationship between the academic sector and other sectors in the network, by the example of the analysed project and in line with the Triple Helix Model assumptions, respondents were asked about the impact of particular sectors on knowledge transfer and innovation creation.

Assuming that:
- in the process of creating innovation one of the key resources is knowledge,
- the academic sector is more closely attributed to basic research, and to a lesser extent, application studies and development work,
- industry is increasingly attributed to research and development works, and to a lesser extent basic research,
- sources of innovation may be of a supply nature (e.g. technological development, new scientific discoveries, etc.) or demand (e.g. consumer demand for a solution or the need to meet new needs) the obtained answers allow the formation of the following conclusions.

Firstly, the genesis of innovation processes is most often linked to the know-how or inventions based on fundamental research, although the invention does not automatically transform into innovation. Scientific discoveries and inventions most often emerge on the academic side, which transfers them to business, if they have the potential to be commercialized. This path is identified with supply sources of innovation related to the transfer of knowledge from the academic sector to the business sector. For the business sector, knowledge from the academic sector combined with internal knowledge, while meeting the other criteria, allows the creation and implementation of innovation.

Secondly, due to growing competition in the market, market research is usually an integral part of the innovation process, most often conducted by the business sector, to verify the marketability of planned innovation, but also to gain insight into customer needs and expectations. Knowledge of this subject can become a determinant of demand for fundamental research and inventions, on the basis of which innovation is desired by consumers. Barriers to business-to-business collaboration can also lead to the business sector striving for self-innovation only by using its own expertise. In the case described above, we are dealing with demand-driven sources of innovation.

It can therefore be argued that respondents' views on the dominant influence of the business sector on knowledge transfer and innovation creation are confirmed in the objective logic of the innovation process, which depends to a certain extent

on the administration sector. It is about objective conditions stemming from the environment in which the academic and business sectors operate, which is exerted by the administration sector. These are, i.a. fiscal, legal, economic, cultural or market conditions, as well as the quality of the business environment, which significantly influences the process of creating innovation and its market cost-effectiveness.

The results identifying the factors that influence the knowledge transfer process between sectors occurring in the Triple Helix Model indicate that knowledge is the key to the process of transferring knowledge. Less importance is attributed to the behaviour of entities in the network and the situation in the sectors involved in knowledge transfer. Even less important is the network environment and society, which is the driving force behind the demand for innovation.

Knowledge is one of the competences of an organization, especially in terms of its ability to generate innovation. The more valuable knowledge resources an organization has, the more important it is to be a partner in the innovation process. It can therefore be stated that the awareness of the value held by knowledge organizations determines their behaviour in the network, and indirectly also influences the situation in particular sectors: academic, business, administrative. Mutual information about knowledge resources triggers the demand for knowledge exchange between organizations, since in the process of creating innovation it is necessary to use internal knowledge and external knowledge. Innovation-oriented organizations are generally not limited to self-production, unless it is due to its unique and low marketability. Acquiring knowledge from the external sources may be about the same sector or other sectors, but it is always about the transfer of knowledge that is useful in the innovation process. Doubts are raised by the results of a study on the low assessment of public participation as a consumer of innovation in the knowledge transfer process. Perhaps networkers focus primarily on supply sources of innovation, with little relevance to the opinion of the public, i.e. potential buyers of innovation. Another reason may be the selection of evaluated components that are not identified by the respondents with the results of knowledge transfer. As regards the importance of the environment in the knowledge transfer process, the respondents were asked above all for the macroeconomic factors which turned out to be insignificant in the process of knowledge transfer for them. It can therefore be concluded that knowledge transfer processes are, in the opinion of respondents, undertaken by organizations mainly on their own initiative, based on transfer of knowledge in sectors or across sectors. The efficiency of these processes is primarily determined by the product – i.e. knowledge transferred: its price, value, availability, etc.

Thus, knowledge is the main catalyst for network collaboration between organizations, rather than favourable environmental conditions, including the interest of society as a consumer of innovation. It can therefore be stated that organizations participating in the researched network are primarily oriented towards innovations resulting from supply factors such as access to knowledge, technology and organizational solutions. At the same time, the behaviour of these organizations is much less sensitive to environmental factors, including the expectations of potential buyers of innovation. This can largely be determined by the nature of the knowledge to which they have access. While this is primarily technical knowledge, innovators are primarily focused on technological solutions, and only later verify their marketability. If innovators have better access to knowledge about the needs of potential consumers of innovation, then the innovation process begins with an analysis of these needs, which determines further demand for technical knowledge.

Regarding the most significant results of the knowledge transfer process, respondents pointed to the core of future innovations, i.e. the know-how and technology, but also highly valued macroeconomic effects such as high quality economy, new jobs and new growth. Thus, in the opinion of the respondents, the transfer of knowledge, enhancing the innovativeness of the cooperating organizations in the network leads to the desired macroeconomic effects, the new quality of the economy, and consequently changes in the sectors and changes in the behaviour of organizations cooperating in the network. Their situation is influenced by elements of the environment, although it should be remembered that as stated above, innovative processes in networks are run primarily by high quality knowledge. Knowledge transfer is a factor that changes the behaviour of network participants and the situation in sectors, and indirectly also affects the network environment in which innovative processes take place.

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