

University's knowledge transfer capacity – organisational structures and regional cooperation

PAWEŁ GŁODEK
EDWARD STAWASZ

University of Lodz, Poland

Department of the Entrepreneurship and Industrial Policy,

Keywords

University commercialisation of knowledge university's organisational structure university's co-operation with the environment

The paper presents the analysis of universities' potential for knowledge transfer to the business environment. The first part of the paper shows the analysis of university organisational units related to various parts of the innovation process. Each stage of the process creates distinct challenges for university operations, hence in the paper the basic framework to observe the capacity of organisational structures to respond to them has been constructed. The analysis focuses on relatively large units with complex operations, such as technology transfer centres, as well as on the organisational role of one-man positions, such as dean's representatives for business relations. The results of the theoretical analysis are referred to the results of the research concerning knowledge transfer practices among universities in Lodz (Poland). A total of thirty-five cases of knowledge transfer practices were included in the analysis. The analysis conducted in the Lodzkie Region covered types of practices, the initiative of carrying out practices, their duration, the nature of practices, their subject scope and impact, as well as risks and benefits associated with implementing knowledge transfer practices. The preliminary exploration, interviews and innovation studies conducted indicate that the analysis covered a vast majority of such practices

Introduction

New solutions generated by the R&D sector constitute a strong base for the modern economy (Drucker, Goldstein 2007). Therefore, the need to incur significant expenditure on science at the macro-economic level is indicated. It is pointed out, however, in many contexts that the knowledge derived from the widely understood sphere of science is not automatically commercialised in the form of new products or services. The enormous complexity of the process of commercialisation of knowledge in the conditions of higher education institutions is emphasised (Głodek, Wiśniewska, 2015), along with the complexity of processes associated with implementation and dissemination of knowledge (Audretsch, Aldridge, 2009). It is, therefore, difficult to understand, and in particular precisely identify, individual sub-processes that make up the process of knowledge transfer. Consequently, it is difficult to understand what components a university's capacity in this area should consist of (Etzkowitz et al., 2000).

A university is one of the major links in the process of commercialisation of knowledge in the economy, thus its potential to participate in this process affects significantly the ultimate success (Hughes, Kitson 2012). Hence, the aim of the paper is to identify factors related to the creation of the potential of a university's organisational structure in the area of knowledge transfer to the business environment. An additional aim is to analyse the possibility of using a simplified

approach to the assessment of a university's structures in the context of their usefulness within the framework of complex processes related to commercialisation of knowledge.

The results of the theoretical analysis are referred to the results of research concerning practices of knowledge transfer among universities in Lodz. A total of thirty-five cases of knowledge transfer practices were included in the analysis. The analysis covered types of practices, the initiative of carrying out practices, their duration, the nature of practices, their subject scope and impact, as well as risks and benefits associated with implementing knowledge transfer practices. The preliminary exploration, interviews and innovation studies conducted indicate that the analysis covered a vast majority of such practices, which means that it is representative of the Lodzkie Region.

The university in the context of management of processes related to commercialisation of knowledge

A university by its very nature is an entity collecting the existing knowledge, processing it in the process of analysis, and consequently generating its new components through research processes. The effectiveness of these processes determines a university's potential in building knowledge resources that can be transferred out. Nevertheless, the capacity for external transfer of knowledge refers to another set of organisational competencies than its creation. Actions undertaken in the framework of various types of partnership relating to forms of knowledge transfer require from a university the implementation of the right quantity and, which is of key importance in this case, the right quality of internal organisational processes. Philbin (2010) points out in this context the process approach as one of the elements in building universities' competitiveness.

The process approach is particularly advisable for knowledge management within universities. Arvanitis, Kubli and Woerter (2008) indicate differences between universities and industry partners, such as aims, culture, and the bureaucratic structure. At the same time, these elements can be considered as one of the consequences of disrupted processes of knowledge circulation within a university, among its employees and among its individual organisational units. Łobacz and Niedzielski (2015) point to significant barriers within universities that limit obtaining information directly related to commercialisation of knowledge.

In the context of creating a university's capacity to build the potential for transfer of knowledge, one can point to the need to pursue the implementation of at least three types of action (Tidd, Bessant, and Pavitt, 2005): (i) search for and identification of ideas (project planning), (ii) evaluation and selection of ideas/projects, (iii) their implementation within the framework of business practice. It should be emphasised that from the point of view of management, these areas are interdependent – thus the efficient implementation of each of them affects the possibility of achieving the favourable results in the remaining areas. On the other hand, imperfections in the implementation of one of the stages seriously reduce the effectiveness of the overall process. In simple terms, it can be said that the lack of identified ideas makes it impossible to assess them and consequently evaluate their practical application. Even if the organisation is well-prepared for their implementation. Thus, the stages of the process need to be regarded as interdependent.

Adapting this model to a university's realities must take into account its particular specificity, referring especially to its research-related orientation. It constitutes one of the basic functions of a university, i.e. generation of new knowledge. This knowledge, created mainly in the context of basic research, should also be subject to management processes to constitute a base for external transfer. Knowledge management in this context can be understood as a process of identifying, acquiring and multiplying knowledge within the organisation in order to improve its competitiveness (Von Krogh 1998). The purpose of knowledge management is, therefore, related to the very practical dimension concerning the need to support organisational capabilities through a better use of individual and collective knowledge resources in the organisation. These resources include skills, abilities, experience, routine, norms, and technologies (Probst 1998).

Lichtenthaler and Lichtenthaler (2009) emphasise that knowledge management processes refer not only to the organisation's internal relationships and resources, but in the realities of the modern economy, in particular the processes associated with open innovation, they are related to external knowledge management. This applies not only to the competencies in the field of its absorption, but also the competencies related to building knowledge links and knowledge dissemination in the environment (Table 1).

	Knowledge exploration	Knowledge retention	Knowledge exploitation
Internal processes (intra-organisational)	Inventive capacity	Transformative capacity	Innovative capacity
External processes (inter-organisational)	Absorptive capacity	Connective capacity	Descriptive capacity

Table 1. Organisational competencies related to knowledge management.

Source: (Lichtenthaler, Lichtenthaler, 2009)

With regard to the determinants of university operations and the analysis of the role of the environment, taking into account both perspectives is essential. As the perspective related to building a knowledge base within a university is widely recognised and in recent years a debate on the need for the widespread use of various forms of knowledge commercialisation has significantly intensified, this point of view takes into account mainly the prospect of the use of knowledge already developed within a university. The use of the knowledge existing outside a university requires it to build structures, and thus also develop processes, that will support its ability to absorb knowledge, especially that originating from the business sphere. On the other hand, an increase in the awareness of the importance of various forms of knowledge commercialisation, associated with commercial and non-commercial processes, is noticeable.

In the light of the above-presented considerations, two perspectives will be taken into account concerning the analysis of organisational structures involved in innovation processes within a university:

1. the perspective of commercialisation of knowledge developed on the basis of internal resources;

2. the perspective of commercialisation of knowledge developed on the basis of cooperation with the business environment.

Within the perspective of commercialisation of knowledge developed on the basis of internal resources, the following process stages will be taken into account: (i) generation/formation of ideas, (ii) search for and identification of ideas, (iii) evaluation and selection of ideas/projects, (iv) their implementation within the framework of business practice.

Within the framework of the perspective of commercialisation of knowledge developed in cooperation with the business environment, the following process stages will be taken into account: (i) seeking areas of cooperation with external partners, (ii) seeking the area of cooperation, (iii) building partnership, (iv) development of cooperation.

The application of the process approach perspective enables the analysis and comparison of a university's institutional solutions relating to commercialisation of knowledge, including cooperation with enterprises. Cooperation with enterprises is taken into consideration as an important component of the process of knowledge commercialisation.

Knowledge transfer between universities and industry in the region

Applicable knowledge (innovative ideas) forms the basis of innovation. Its acquisition is a prerequisite for the implementation of innovation in the enterprise. Sources of innovation in the case of enterprises can be divided into internal (the company's own resources), external (outside the company) and mixed ones (Burgelman et al. 2004). The internal sources include research generated within the company, the ingenuity of its employees. For an innovative company, the main advantage is the exclusivity of its solutions and the main disadvantage is the high uncertainty of desired effects, along with long lead times and high implementation costs. External sources of knowledge include research arising from outside of the company, licences, acquisitions, and joint ventures. External solutions are the easiest way of acquiring new knowledge, an effective and less risky method, but they can cause dependence on suppliers of knowledge.

Transfer of knowledge can be described as the flow of solutions between different entities (Bozeman 2000). It is a special case of the process of communication. This process is very often interactive, and includes various feedback loops between the providers and recipients of knowledge (Bessant, Tidd 2007; Burgelman et al. 2004). It includes any form of diffusion of solutions and technical education. Knowledge transfer means the transfer of the information necessary for one entity to be able to duplicate the work of another entity. This information exists in two forms - technical information (engineering knowledge, scientific knowledge, standards) and procedures-related information (including legal contracts, confidentiality agreements, patents, licences). It is usually a market process in which a technology is bought and sold. Transfer of knowledge means, therefore, the transfer of specific technical or organisational knowledge and the related know-how for the purpose of economic exploitation.

Knowledge transfer may be divided into commercial and non-commercial (Grimpe, Hussinger 2013; Brown 2016). Non-commercial knowledge transfer includes, among others: (1) knowledge transferred free of charge, studies, internships, etc. (2) vocational and professional associations, (3) mutual transfer of licences, (4) knowledge transferred within companies, for example, multinational corporations. Commercial knowledge transfer encompasses the flow of

knowledge and technology between entities not related structurally and includes: (1) materialised (hard) transfer, (2) sale of invention licences, utility models and know-how, (3) and widely understood information, including tacit knowledge.

Knowledge transfer takes place primarily between the science and research sector and the industry sector, creating a unique bridge between the two worlds and bringing many economic, market, organisational, and educational benefits to both parties (Bozeman 2000). In the process of knowledge transfer, the following entities are partners in the framework of various systems: universities, laboratories, large, medium-sized and small enterprises, public institutions and private individuals. A characteristic feature of the cooperation between universities and companies is the presence of many cultural and organisational differences between the two sectors (different motivations, goals and ways of conducting operations, criteria for performance appraisal, etc.). This creates many difficulties for the establishment and continuation of effective cooperation in the field of knowledge transfer (Hewitt-Dundas 2012).

Transfer of knowledge from universities to companies is conducted through various channels and organisational forms (D'Este, Patel 2007; Conway, Steward 2009; Muscio, Vallanti 2014; Brown 2016), mainly by means of:

- joint research and targeted projects implemented in cooperation with enterprises;
- contract research commissioned by companies,
- sharing licences for different forms of intellectual property, know-how;
- advisory services, opinions, expert opinions, reviews, as well as scientific and technical intermediary services,
- transfer of technical personnel, training,
- spin-off companies,
- scientific and popular science publications, patent descriptions,
- informal contacts between scientists,
- Staff mobility programmes (exchange/transfer of employees from the science to business sphere and vice versa), student internships.

An important role in transfer of knowledge from universities to companies is played by the regional innovation policy (Shane 2005; Chai, Shih 2016). In functional terms, it is a specific forum for cooperation between different types of organisations and institutions operating in the region, whose main purpose (or one of the objectives) is the development of innovative entrepreneurship in the region. A kind of functional network connecting all entities operating in the field of innovation and technology transfer is created in the framework of this regional structure. The regional innovation policy is characterised by the focus on the demand aspect of innovations, requiring interactions between enterprises, especially SMEs, and the sphere of research, science and technology (Stawasz 2015). This is due to the proximity and greater confidence in the partners coming from the same area, professing the same values determined by the same cultural factors (Huggins et al. 2012; Maietta 2015; Segarra-Blasco, Arauzo-Carod 2008). Knowledge and innovation transfer services between universities and local businesses are provided mainly by regional institutions of the innovative business environment, as well as commercial providers operating in the area of entrepreneurship, innovation, technology transfer and commercialisation.

The status and development prospects of this sphere of the economy, as well as the quality and range of services provided have an increasingly visible impact on transfer of knowledge and innovation in the case of individual companies and the overall economy (Lahmann, Menter 2015).

The perspective of commercialisation of knowledge developed on the basis of universities' internal resources

The perspective of commercialisation of knowledge developed on the basis of universities' internal resources can be generally referred to the concept of science-push innovation (Van den Ende and Dolfsma 2005). In this perspective, the knowledge base created within a university is developed on the basis of research aimed at understanding the widely understood reality. The rationale for the research work conducted is, therefore, not the potential of its practical application. The possibility of practical application of knowledge may be a subject of analyses carried out subsequently, generally after its creation. Stawasz (2009) indicates the existence of the research project-application undertaking system which seeks to address the challenge of somehow translating knowledge into the possibilities of economic exploitation of research results.

Table 2 presents a simplified assessment of effectiveness of the use of individual instruments in the process of creating the supply of knowledge with a commercial potential. This process is a component of innovation processes within a university and is understood as a sequence of actions aimed at building the university's offer, including specific proposals for cooperation with enterprises (and more broadly – with the environment), or at commercialisation in the form of spin off companies.

Components of a university's organisational structure characterised in the previous section have been evaluated for their effectiveness in terms of the requirements generated by the subsequent stages of the innovation process carried out within a university. A four-point scale evaluating the effectiveness of the given solution was used: “the lack of the use of a particular solution in the given phase”, “low effectiveness of the solution”, “moderate effectiveness of the solution” or “high effectiveness of the solution”. The distribution of areas of operation of individual units among different stages of the innovation process is visible. Individual units that carry out parallel activities in different stages of the process can be identified. In this system, some overlap between the activities of the various academic units is clear. This should not be read, however, as the duplication of competencies, but rather something that stems from the need to use different instruments to achieve results in the implementation of complex tasks.

Name of university unit	The search for new knowledge with commercial applications	Evaluation and selection	Knowledge transfer	Post-transfer
University technology transfer centre	+	+++	+++	+
Dean's representative for business relations	+	+	-	+
Rector's representative for business relations	-	-	-	-
Innovation broker	+	++	+++	-

Commonly accessible university databases	+	-	-	-
Academic technology incubator	-	-	+	+++
University network of technology scouts	+++	++	+	-

Table 2: Simplified assessment of the significance of university organisational units in the process of creating new ventures for knowledge commercialisation.

Description: “-” the lack of the use of a particular solution in the given phase, “+” low effectiveness of the solution, “++” moderate effectiveness of the solution, “+++” high effectiveness of the solution.

Source: the authors' own compilation based on the concept of Głodek, Wiśniewska (2015).

Taking into account the complexity of the processes analysed, ideal solutions prevailing over the others cannot be indicated, however, solutions leading in significance can be identified in each of the stages. Focusing on the key institutions at the different stages of a university's innovation process, the management model of this process can be completed with new elements.

The perspective of commercialisation of knowledge developed in cooperation with the business environment

The perspective of commercialisation of knowledge developed in cooperation with the business environment can be generally referred to the concept of market-pull innovation (Van den Ende, Dolfsma 2005). In this perspective, research activities (at different scales) are conducted at a university in the context of the potential demand on the part of business practice. From this point of view, a key challenge is to build a university's capacity to collaborate with external partners, including not only the identification of areas of potential cooperation, but also activities for its implementation in terms of scientific aspects and different types of organisational determinants.

Table 3 presents a simplified assessment of effectiveness of the use of the individual components of a university's structure in the process of cooperation with the business environment. Similarly, as shown in Table 2, the distribution of areas of operation of individual units at the different stages of the innovation process is apparent in this respect. The process approach also in this case provides a fairly clear distinction between the significance/activity of university structures.

Using a similar approach as in the previous section, a diagram indicating the major actors in the analysed process has been prepared. Thus, in the framework of the diagram, the leading components of a university's organisational process and the units supporting these activities can be indicated. Differences in the significance of university units at various stages of the innovation process carried out in the framework of building platforms of cooperation with the environment are, however, clearly visible.

Name of university unit	Seeking areas of cooperation with external partners	Seeking the area of cooperation	Building partnership	Development of cooperation
Dean's representative for business relations	++	+	-	+
Rector's representative for business relations	+	+	-	-
Innovation broker	+	++	++	-
Commonly accessible university databases	+	-	-	-
University technology transfer centre	+	++	+++	++
Academic technology incubator	-	-	-	+
University network of technology scouts	+++	++	+	+

Table 3: Significance of university units in supporting the processes of commercialisation of knowledge developed in cooperation with the business environment.

Description: “-” the lack of the use of a particular solution in the given phase, “+” low effectiveness of the solution, “++” moderate effectiveness of the solution, “+++” high effectiveness of the solution.

Source: the authors' own compilation.

Knowledge transfer between universities and SMEs in the Lodzkie Region

The Lodzkie Region, according to the results of the assessment conducted by the European Commission, is a weak innovator at the average level (Regional Innovation Scoreboard 2014). The use of the services related to the widely understood knowledge transfer is limited but also very diverse. Approximately 1,000 companies use such services in a systematic and formalised manner, representing about 1% of all active innovative companies. The vast majority of local companies use transfer services in the region occasionally (and informally), or do not need such services, often indicating a lack of awareness (belief) about the possibilities offered by external cooperation in the field of innovation. In addition, they often do not have the knowledge of the existing institutional solutions and services offered in the region. The companies also evaluate very poorly the existing opportunities for cooperation with universities, research centres and technology transfer organisations in the region.

The analysis covered a total of thirty-five cases of practices of knowledge transfer between universities and small and medium-sized enterprises (SMEs) in the Lodzkie Region. The study encompassed: types of practices, the initiative of carrying out practices, their duration, the nature of practices, their subject scope and impact, as well as risks and benefits associated with implementing knowledge transfer practices. The preliminary exploration, interviews and innovation studies show that the analysis covered the vast majority of such practices, which means that it is representative of the Lodzkie Region. The paper makes use of the results of the

empirical research conducted in the framework of the international project “Innovation Policy in University City Regions - INNOPOLIS” (Program INTERREG IVC).

Types of knowledge transfer

Practices of knowledge transfer between universities and companies can be divided into seven types (Tab. 4). Simple, less advanced practices prevail. Practices in the framework of cooperation in the field of training and education addressed to students, as well as university and company employees and others (40.5% of the cases) dominate. Knowledge transfer between universities and companies in the framework of contracts (23.8%), mostly research ones, plays an important role, as well as informal cooperation which refers to practices that take place without the consent of both interested parties (9.5%). Informal cooperation concerns most often the use of a university's research infrastructure or research results free of charge and without its consent, as well as conducting training on a university's premises.

No.	Types of knowledge transfer	% of the practices
1.	Training and education	40.5
2.	R&D contracts	23.8
3.	Informal cooperation	9.5
4.	Use of research infrastructure	7.1
5.	Strategic cooperation	7.1
6.	Joint venture	2.4

Table 4: Types of knowledge transfer between the studied universities and SMEs

Source: the authors' own calculation.

Other types of knowledge transfer between universities and companies occur less frequently. These include transfer of knowledge in the framework of companies' use of research infrastructure (7.1% of the cases) and in the framework of strategic cooperation between universities and companies (only three cases - 7.1%). In only one case, there was an exchange of knowledge between universities and companies in the form of joint venture, considered a very advanced form of knowledge transfer.

Initiative of knowledge transfer

Knowledge transfer practices between universities and companies in the Lodzkie Region were top-down initiatives implemented in the context of the regional policy to promote innovation, initiated by the universities or by the companies themselves. The analysis of the forms of initiating practices of knowledge transfer between the studied universities and companies indicates that they were initiated primarily by the universities (67.6% of the cases), mainly within the framework of various types of cooperation programmes with the economy of the region. Only every sixth case (18.9%) was initiated by the companies themselves, and every seventh case was carried out in the framework of programmes to support innovation in the region (13.5%). Among the 7 cases initiated by the companies, there are four cases carried out in the framework of cooperation developed on a contractual basis (research contracts) and three cases resulting from informal cooperation. Among the 5 cases initiated in the framework of

innovation support programmes, there are four cases conducted on the basis of research contracts, and one case concerning training and education.

Duration and reproducibility of knowledge transfer

Practices of knowledge transfer between universities and companies were analysed in terms of their duration and reproducibility (in other circumstances and institutions). In terms of duration, they are divided into two groups: long-term (more than 6 months) and short-term (less than 6 months). The analysis conducted indicates that short-term practices prevail – 4/5 of all the cases. Long-term practices, i.e. practices more useful for knowledge transfer, constitute only 1/5 of all the cases. All of the cases concerned transfer of knowledge between universities and companies carried out in the framework of contracts or strategic long-term cooperation.

No.	Item	% of the practices
1.	Duration of practices	100
1.1.	Long-term practices	20
1.2.	Short-term practices	80
2.	Reproducibility of practices	100
2.1.	Reproducible	82.6
2.2.	Unreproducible	17.4

Table 5: Duration and reproducibility of knowledge transfer practices.

Source: the authors' own calculation.

More than 4/5 of all the cases (82.6%) are reproducible, which means that they can be used in other circumstances and by other entities. They can thus be disseminated in the region as the so-called “good practices”. Only 17.4% of the cases were unreproducible and difficult to disseminate. This applies in particular to the cases of knowledge transfer between universities and companies conducted in the framework of informal cooperation.

Subject scope of knowledge transfer

In the case of the subject scope of practices of knowledge transfer between universities and SMEs, two types of scope were distinguished in the analysis, i.e. direct cooperation between the two parties and cooperation with the participation of a third party, e.g.: government offices and other stakeholders. The cooperation in the framework of which knowledge transfer occurs only between universities and companies prevailed (77.1% of the cases). A larger number of involved parties was encountered only in 22.9% of the cases. Half of the cases concerned cooperation conducted in the framework of contracts.

Impact of knowledge transfer

In terms of the impact of the analysed practices of knowledge transfer between the studied universities and companies in the region, there are direct effects in the form of knowledge transfer, as well as indirect effects associated with the initiating of knowledge transfer. The conducted analysis of practices of knowledge transfer between universities and companies indicates that indirect effects dominate (62.9% of the cases). Direct transfer of knowledge occurred only in a little over 1/3 of the cases. This shows the weakness of knowledge

transfer between the universities and the SMEs in the region. Only every third case of cooperation yielded direct transfer of knowledge. Those cases relate to cooperation in the framework of contracts, informal cooperation and strategic cooperation, i.e. long-term projects. The remaining 2/3 of the cases are cases of potential transfer of knowledge – indicating the beginning of the process.

Risks and benefits associated with knowledge transfer

The conducted analysis shows that practices of knowledge transfer between the studied universities and SMEs are associated with a small risk of failure – in the case of 70% of the analysed practices, no risk or minimal risk of failure was observed. Only 30% of the analysed practices were affected by the risk of failure, which was considered medium. A noticeable risk of failure occurs mainly in the following cases:

- cooperation undertaken with the participation of a third party, e.g.: business support institutions, technology transfer centres, government agencies (80% of this type of practices),
- cooperation initiated within the top-down (formal) approach, in which both sides, i.e. the universities and the SMEs, are somehow "coerced" to cooperate in the exchange of knowledge (60% of such cases),
- Cooperation in the framework of research contracts, usually associated with a high risk of failure.

Knowledge transfer between the studied universities and SMEs allowed both parties to obtain a number of scientific and research, educational, economic, organisational and market benefits (Table 6). Relatively more benefits were obtained by the companies (97%) than by the universities (88%).

No	Types of benefits	For universities	For SMEs
1.	Economic	43	23
2.	Development of knowledge	20	43
3.	Educational	43	0
4.	Organisational	9	34
5.	Market	6	6

Table 6: Benefits of knowledge transfer between the studied universities and SMEs (% of the cases)

Source: the authors' own calculation.

Both parties involved in knowledge transfer, i.e. the studied universities and SMEs, pointed to different types of benefits:

1. The companies indicated the following benefits:

- a) scientific and research benefits related to obtaining by the companies new or improved knowledge (43% of the cases); it should be noted that the knowledge gained in most cases was implemented into practice (60% of such cases), which proves the high practical value of knowledge transfer,

- b) organisational benefits concerning the development of employees' skills and the improvement of the companies' strategies (34% of the cases),
- c) economic benefits associated with the improvement of business performance, e.g.: reduced production costs, payments for services rendered (23% of the cases),
- d) Market benefits related to commercialisation of knowledge and the improvement of the company's market position (6% of the cases).

2. The universities indicated the following benefits:

- a) economic benefits, e.g.: payments for services rendered (43% of the cases),
- b) educational benefits mainly related to the possibility of carrying out business internships for students (43% of the cases),
- c) scientific and research benefits, related to the development of knowledge in cooperation with companies, e.g.: testing and laboratory examination of technologies within companies (20% of the cases),
- d) organisational benefits associated with the development of scientific staff (9% of the cases),
- e) Market benefits related to commercialisation of knowledge developed at the universities (6% of the cases).

The above-presented review of the benefits obtained shows that the universities obtained mostly economic and educational benefits, while SMEs obtained scientific and research as well as organisational benefits.

Discussion and conclusions

The paper presents the analysis of the process of creating a university's capacity for knowledge transfer to the regional business environment. The existence of a relationship between processes of knowledge generation as well as innovation processes and the institutional system operating within a university was indicated. The understanding of this relationship is important due to the significant interdependence of individual process stages in terms of ability to generate results in the form of knowledge transfer.

The conducted study shows that practices of knowledge transfer are mainly simple, scientifically and technically less advanced. They do not typically require significant changes in the operation of a university's individual organisational units. Strategic, long-term cooperation is very rarely encountered, while short-term, not exceeding six months, co-operation prevails. This fact can be associated with the companies' perception of the relationship with academia in the context of high risk (Goduscheit, Knudsen 2015; Bstieler et al. 2015), which may limit the tendency of companies to develop a deeper commitment to cooperation, even though they obtain relatively more benefits from this cooperation. This factor is gaining importance in the context of the cultural characteristics of Poles estimated with the use of the Hofstede index. Seen from this perspective, attitudes relating to uncertainty avoidance and short-term orientation are an important component of Poland's cultural dimension (Hofstede et al. 2011).

The implemented practices of knowledge transfer are most often reproducible, which means they can be used in other circumstances and by other entities. They can thus be disseminated in the region as the so-called "good practices". The cooperation in the framework

of which knowledge transfer occurs only between universities and companies prevails. The effects of these practices are mostly indirect, representing only the beginning of the process of knowledge transfer.

The paper has implications for the regional innovation policy. The overall structure of the cooperation between the studied universities and SMEs points to a weakness existing in terms of knowledge transfer between the partners. In practical terms, the identified profile of transfer points to the need to strengthen internal processes preparing the universities in the region to knowledge transfer. It seems that the strengthening of the internal structures should aim at increasing the capacity of universities to create stable, long-term and strategic relationships with partners in the business environment. The business sphere also requires state support, especially the smallest enterprises. This applies to the creation of the innovative capacity of companies, especially the ability to absorb knowledge acquired from universities and laboratories, including facilitating access of SMEs to sources of new knowledge created at universities and to highly specialised services for innovation. In particular, it is related to providing specific pro-innovation services in the form of training, advice and promotion of innovation, assistance in deployment, and support in establishing contacts with universities.

The methodology used and the characteristics of the sample cause certain limitations of the study. In particular, this refers to the limited sample size and its focus on one of the Polish regions, which may result in the possibility of error concerning the results for the whole country. On the other hand, the analysis conducted indicates a certain scope for future research, in particular on the relationship between different solutions regarding a university's organisational structures, and its effectiveness in the context of the transfer of technology to its environment.

References

- Audretsch, D., Aldridge, T., T., 2009. Scientist commercialization as conduit of knowledge spillovers. *Annals of Regional Science*, 43, 897-905.
- Bessant, J., and Tidd J., 2007. *Innovation and Entrepreneurship*. Chichester: Wiley.
- Bozeman, B., 2000. Technology transfer and public policy: a review of research and theory. *Research Policy*, 29(4-5), 627-655, DOI: 10.1016/S0048-7333(99)00093-1.
- Brown, R., 2016. Mission impossible? Entrepreneurial universities and peripheral regional innovation systems. *Industry and Innovation*, 23 (2), 189-205, DOI: 10.1080/13662716.2016.1145575.
- Bstieler, L., Hemmert M., Barczak G., 2015. Trust Formation in University-Industry Collaborations in the U.S. Biotechnology Industry: IP Policies, Shared Governance, and Champions. *Product Development & Management Association*, 32(1), 111-121, DOI: 10.1111/jpim.12242.
- Burgelman, R. A., Christensen, C. M., Wheelwright, S.C., 2004. *Strategic Management of Technology and Innovation*. Boston: McGraw-Hill.
- Chai, S., Shih, W., 2016. Bridging science and technology through academic-industry partnerships. *Research Policy*, 45(1), 148-158, doi.org/10.1016/j.respol.2015.07.007.
- Conway, S., Steward, F., 2009. *Managing and shaping innovation*, Oxford: University Press.

- D'Este P., Patel, P., 2007. University - industry linkage In the UK: What are the factors underlying the variety of interactions with industry? *Research Policy*, 36, 1295-1313.
- Drucker, J., Goldstain, H., 2007. Assessing the Regional Economic Development Impacts of Universities: A Review of Current Approaches. *International Regional Science Review*, 30(1), 20-46.
- Etzkowitz, H., Webster, A., Gebhardt, Ch., Cantisano Terra B.R., 2000. The future of the university and the University of the Future: evolution of ivory tower to entrepreneurial paradigm. *Research Policy*, 29(2), 313-330.
- Głodek, P., Wiśniewska, M., 2015. Uczelniany scouting wiedzy, jako element systemu komercjalizacji wiedzy w ramach uczelni wyższej. *Ekonomiczne Problemy Usług*, 121, Zeszyty Naukowe Uniwersytetu Szczecińskiego nr 891, Szczecin, 279-292.
- Goduscheit, R., Ch., Knudsen, M. P., 2015. How Barriers to Collaboration Prevent Progress in Demand for Knowledge: A Dyadic Study of Small and Medium-Sized Firms, Research and Technology Organizations and Universities. *Creativity and Innovation Management*, 24(1), 29-54, DOI: 10.1111/caim.12101.
- Grimpe, Ch., Hussinger, K., 2013. Formal and Informal Knowledge and Technology Transfer from Academia to Industry: Complementarity Effects and Innovation Performance. *Industry and Innovation*, 20 (8), 683-700, DOI: 10.1080/13662716.2013.856620.
- Hewitt-Dundas, N., 2012. Research intensity and knowledge transfer activity in UK universities. *Research Policy*, 41 (2), 262-275.
- Hofstede G., Hofstede G. J., Minkov M., 2011, *Kultury i organizacje, zaprogramowanie umysłu*, 3rd edition, PWE, Warsaw.
- Huggins, R., Johnston, A., Stride Ch., 2012. Knowledge networks and universities: Locational and organizational aspects of knowledge transfer interactions. *Entrepreneurship & Regional Development*, 24 (7-8), 475-502, doi.org/10.1080/08985626.2011.618192.
- Hughes, A., Kitson, M., 2012. Pathways to impact and the strategic role of universities: new evidence on the breadth and depth of university knowledge exchange in the UK and the factors constraining its development. *Cambridge Journal of Economics*, 36, doi:10.1093/cje/bes017.
- Krogh, G. Von, 1998. Care in Knowledge Creation. *California Management Review*, 40(3), p. 133-153.
- Lehmann, E. E., Menter, M., 2015. University-industry collaboration and regional health. *Journal of Technology Transfer*, 1-24, DOI 10.1007/s10961-015-9445-4.
- Lichtenthaler, U., Lichtenthaler, E., 2009. A Capability-Based Framework for Open Innovation: Complementing Absorptive Capacity. *Journal of Management Studies*, 46(8), 1315-1338.
- Łobacz, K., Niedzielski, P., 2015. Uczelnie wyższe, jako element procesu komercjalizacji wiedzy w Polsce - wyzwania i bariery. In: P. Głodek, M. Wiśniewska, (Eds.), *Budowa potencjału uczelni wyższej do współpracy z przedsiębiorstwami. Rola scoutingu wiedzy*. Łódź: University of Lodz, 81-104.
- Maietta, O. W., 2015. Determinants of university-firm R&D collaboration and its impact on innovation: A perspective from a low-tech industry. *Research Policy*, 44(7), 1341-1359, <http://dx.doi.org/10.1016/j.respol.2015.03.006>

- Arvanitis, S., Kubli, U. & Woerter, M., 2008, University-Industry Knowledge and Technology Transfer In Switzerland: What University Scientists Think About Cooperation With Private Enterprises, *Research Policy*, 37, 1865-1883.
- Muscio, A., Vallanti, G., 2014. Perceived Obstacles to University-Industry Collaboration: Results from a Qualitative Survey of Italian Academic Departments, *Industry and Innovation*, 21(5), 410-429, DOI: 10.1080/13662716.2014.969935.
- Pinto, H., Fernandez-Esquinas, M., Uyarra, E., 2015. Universities and Knowledge-intensive Business Services (KIBS) as Sources of Knowledge for Innovative Firms in Peripheral Regions. *Regional Studies* 49, 1873-1891, doi.org.ebscohan2320.han3.lib.uni.lodz.pl/10.1080/00343404.2013.85396
- Philbin, S. P., 2010, Developing and Managing University-Industry Research Collaborations through a Process Methodology/Industrial Sector Approach, *Journal of Research Administration*, Vol. XLI, no. 3, 51-68.
- Probst, G., 1998. *Practical Knowledge Management: A Model That Works*, Prism, Second Quarter, Arthur D. Little.
- Regional Innovation Scoreboard 2014*, 2014. European Commission, doi: 10.2873/84730.
- Segarra-Blasco, A., Arauzo-Carod, J.-M., 2008. Sources of innovation and industry-university interaction: Evidence from Spanish firms. *Research Policy*, 37, 1283-1295, doi:10.1016/j.respol.2008.05.003.
- Shane, S., 2005. Government policies for encourage economic development through entrepreneurship: the case of technology transfer. In: S. Shane (Ed.), *Economic development through entrepreneurship. Government, university and business linkages*, Cheltenham: Edward Elgar, 33-49.
- Smith, H., L., Baghi-Sen, S., 2012. The Research University, entrepreneurship and regional development: Research propositions and current evidence. *Entrepreneurship & Regional Development*, 24 (5-6), 383-404, doi.org/10.1080/08985626.2011.592547.
- Stawasz, E., 2009. Wybrane zagadnienia metodyki oceny projektów transferu technologii. In: Z. Wysokińska, E. Stawasz, P. Głodek (Eds.), *Wybrane metody i mierniki oceny transferu technologii w obszarze innowacyjnych projektów i ich efektów rynkowych*, Radom: Instytut Technologii Eksploatacji. Państwowy Instytut Badawczy, 93-120.
- Stawasz, E., 2015. Determinants of knowledge transfer processes in a region. In: E. Sobczak, B. Bal-Domańska, A. Raszkowski (Eds.), *Local and Regional Economy in Theory and Practice, Research Papers of Wrocław University of Economics*, 394, Wrocław: Uniwersytet Ekonomiczny we Wrocławiu, 166-174.
- Tidd J., Bessant J., Pavitt K., 2005, *Managing Innovation. Integrating technological market and organizational change*. John Wiley & Sons Ltd.
- Van den Ende, J., Dolfsma, W., 2005. Technology-push, Demand-pull and the Shaping of Technological Paradigms: Patterns in the Development of Computing Technology. *Journal of Evolutionary Economics*, 15(1), 83-99.
- Wiśniewska, M., Głodek, P., 2015. Scouting wiedzy w ramach uczelni wyższej. In: P. Głodek, M. Wiśniewska (Eds.), *Budowa potencjału uczelni wyższej do współpracy z przedsiębiorstwami. Rola scoutingu wiedzy*. Łódź: University of Lodz, 11-24.

Author(s) and submission details

Paweł Głodek

University of Lodz, Poland

Department of the Entrepreneurship and Industrial Policy

Email: glodek@uni.lodz.pl

Edward Stawasz

University of Lodz, Poland

Department of the Entrepreneurship and Industrial Policy

First submission: 28th September 2016

Revised submission: 22nd November 2016

Paper accepted: 7th December 2016
