Journal of Infrastructure, Policy and Development 2024, 8(15), 9818.
https://doi.org/10.24294/jipd9818

Article

Modelling the knowledge flow among vocational training and its partners

Hajnalka Hatos[1], Márta Konczos Szombathelyi[2,*]

[1] Doctoral School of Regional and Economic Sciences, Széchenyi István University, 9026 Győr, Hungary
[2] Kautz Gyula Faculty of Economics, Leadership and Marketing Department, Széchenyi István University, 9026 Győr, Hungary
*** Corresponding author:** Márta Konczos Szombathelyi, kszm@sze.hu

CITATION

Hatos H, Konczos Szombathelyi M. (2024). Modelling the knowledge flow among vocational training and its partners. Journal of Infrastructure, Policy and Development. 8(15): 9818. https://doi.org/10.24294/jipd9818

ARTICLE INFO

Received: 22 October 2024
Accepted: 8 November 2024
Available online: 17 December 2024

Abstract: The study documents the model of the knowledge transfer process between the University, the Vocational Training Center and the industrial actors. The research seeks to answer to the following questions. Where is new knowledge generated? Where does knowledge originate from? Is there a central actor? If so, which organization? Hypotheses tested by the research: H1: Knowledge starts from the higher education institution. H2: Most "new knowledge" is generated in universities and large multinational companies. H3: The university is a central actor in the knowledge flow, transmitting both hard and soft skills, as well as subject ('know-what'), organizational ('know-why'), use ('know-how'), relational ('know-who'), and creative ('care-why') knowledge. The aim of the research is to model the way of knowledge flow between the collaborating institutions. The novelty of this research is that it extends the analysis of the knowledge flow process not only to the actors of previous researches (higher education institutions, business organizations, and government) but also to secondary vocational education and training institutions. The methodology used in the research is the analysis of the documents of the actors investigated and the questionnaire survey among the participants. Knowledge transfer is the responsibility of the university and its partner training and business organizations. In vocational education and training, knowledge flows based on the knowledge economy, innovation and technological development are planned, managed and operational. The research has shown that knowledge is a specific good that it is indivisible in its production and consumption, that it is easy and cheap to transfer and learn.

Keywords: dual training; modelling knowledge flows; vocational training

1. Introduction

Socio-economic changes, technological developments, industrial revolutions have all had an impact on the rise to prominene of knowledge. The fourth industrial revolution, Industry 4.0, is based on the knowledge economy. The definition of knowledge has expanded in the 21st century to include concepts such as artificial intelligence, robots, integrated circuits, and the innovative economy. Vocational education and training (VET) is responsible for producing the skilled people with the knowledge needed for the labor market. This is not a task for secondary schools alone, but also for universities and companies thinking and working in partnership with them.

In vocational education and training, the knowledge economy, the flow of knowledge based on innovation and technological progress, is a consciously planned and managed process. The government, the European Union and regional and municipal regulation are strong in Hungary. As a result, regional knowledge creation, functional knowledge transfer and knowledge brokerage relationships are dominant in everyday life. Knowledge transfer is a core task of universities, schools and the dual training organizations that collaborate with them.

Previous researches on knowledge flows has looked at the relationship between universities and industry, with associated government-level regulations and complemented by environmental, media and civil society factors. There is a large body of literature on the availability of knowledge at the university, the transfer of knowledge to industry and the potential for innovation to be reflected in technological processes, thereby triggering economic development, as Padilla et al. have shown in their literature review. The main questions that have been addressed in the studies are who generates the knowledge flows and how it is transferred, as was done by Dalmarco, who conceptualized knowledge flows in terms of the direction and content of knowledge. It would be important to define a methodology as a roadmap for identifying factors that improve the performance of knowledge transfer from university to industry (Padilla et al., 2023).

Matthies et al. looked at vocational education and training and the position of vocational training companies in innovation. Germany is the location of the research, but it follows a Swiss model. The final conclusion is that the knowledge diffusion function that the VET system has in knowledge-based economies such as Germany, Switzerland or Norway is important for smaller training firms (Matthies et al., 2024).

Rahman et al. investigated the factors influencing knowledge sharing among vocational teachers. They found that knowledge is the focus of the higher education institution, which requires that it be managed effectively. Knowledge sharing helps trainers' productivity, creativity and innovation. Academics who share their knowledge are useful to their institutions. In other words, there are the same dimensions as those examined in this thesis, but not from the same perspective (Rahman et al., 2024).

Previous researches have either presented details of internal knowledge sharing or classical solutions of external knowledge sharing between actors (universities, industry, and government). Environmental impacts have been examined, but not at the level of secondary vocational education and training.

This research aims to model the way of knowledge flows between collaborating institutions (university, secondary vocational school, and business organizations).

The study seeks to answers to the following questions. Where is new knowledge created? Where does knowledge come from? Is there a central actor? If so, which organization?

2. Materials and methods

2.1. Theoretical theorems, findings

My hypotheses were helped by the following theoretical theorems summarized by Imre Lengyel. The intensive cooperation of local actors is essential for local knowledge creation, as formulated in the Triple Helix2 model. This model is based on the recognition that successful local knowledge creation requires a vibrant relationship between the scientific sector (academia, universities), the profit-oriented economy (competition) and the government sector (public sector) as illustrated in **Figure 1**. Whereas in the past, scientific research (especially in universities) and business developed in separate paths, with the state only providing the background conditions, today the three sectors are working closely together. The constant communication

between the institutions of these three spheres, the improvement in the efficiency of knowledge transfer between them, and the blurring of their boundaries, all ensure the 'intertwined' development of all three spheres (Lengyel, 2012).

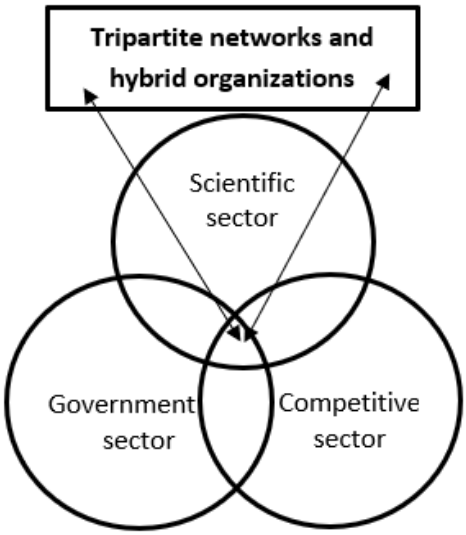

Figure 1. The triple helix model (own editing based on Etzkowitz and Leydesdorff 2000; Lengyel, 2012).

Figueiredo et al. in their research on the Triple Spiral model, collaboration in knowledge creation, argue that a common goal and a good choice of partners are important for the success of collaboration. The mission of universities is to contribute to the economic development of enterprises through the development of research, knowledge and innovation. Government support and public funding strengthen cooperation and reduce competition. Greater emphasis is placed on research and development, so that innovations can be translated into practical technology to help economic growth. Knowledge is at the heart of these relationships. Long-term cooperation should be considered (Figueiredo et al., 2023).

In the threefold model described by Leydesdorff, new research trends emerge in the network of government, industry and science, as a result of technological progress and changes in the environment. In knowledge-based economies, expectations and their interactions form the basis of the social order, reshaping the institutional arrangements in the industry-university-government relationship. Innovation and flexibility will be crucial to the triple system (Leydesdorff, 2000).

With the triple helix of university-industry-government relations no longer expected to stabilize, Leydesdorff argues that knowledge-based innovation policies should aim to influence the political economy of technology at the regime level, and not just address the trajectory of further developments (Leydesdorff, 2005).

> "The notion of a knowledge-based economy, or learning economy, has come to the fore with the rise in the share of the service sector and the importance of knowledge-intensive activities, and the spread of digital technologies" (Lengyel, 2021).
>
> "... Industry 4.0 is based on the knowledge-based economy ... In other words, the knowledge-based economy has come to the fore today, which is also called the

> digital, network, information, service-based, innovative, etc. economy..." (Lengyel, 2021).
>
> "Knowledge is a special good ... non-competitive and only partially exclusive of others. Furthermore, its production and consumption are indivisible, it can be easily and cheaply transferred and learned, ..." (Lengyel, 2021).
>
> "... knowledge goods are person-dependent ... they are not scarce, i.e., they do not run out when shared with others and are difficult to measure" (Lengyel, 2021).

Lengyel describes multiple ways of knowledge creation, with the network of organizations, teamwork, and innovation appearing alongside the individual. The bulk of new knowledge is created in two basic sectors, corporate and institutional, which I will examine.

> "The role of the different types of knowledge base in the creation and flow of knowledge, in the process of research, development and commercialization, is different. The analytical knowledge base is of paramount importance in the research phase, while it is variable in the development phase and negligible in the sales phase. In science-based collaborations, geographical proximity is less important, and scientific research can be carried out with distant partners, with similarly qualified individuals and departments. The synthetic knowledge base is essential for development, where geographical, institutional and organizational proximity are relied upon, essentially exploiting agglomeration advantages. The symbolic knowledge base comes to the fore in marketing, drawing on both geographical and institutional proximity." (Lengyel, 2021).

Universities also play an important role in the creation and flow of knowledge. University knowledge transfer to economic actors can take the form of publication of research results, sale of patent specifications (Codified Knowledge Flows), through networks of formal or informal contacts, joint research between university and business experts (Knowledge Transfer), leasing of physical university facilities (e.g., libraries, scientific research laboratories), or local knowledge spill overs, spin-off companies from universities, technology sales (Knowledge Diffusion). In addition to universities, knowledge flows between economic actors and companies are also important. Some of these are planned, e.g., research cooperation with universities, knowledge purchase from knowledge-intensive service providers, investment in local R&D cooperation, monitoring technological change. While the other part is unplanned, e.g., spontaneous knowledge spills over between the company and its customers, or labor mobility between firms with similar technologies. The frequency and intensity of knowledge flows also depend on distance, being mostly intense in local areas, but also observable in distant business partners (Lengyel, 2021).

I think that knowledge transfer and diffusion is the basis of everything in the field of education and training. It can be stated that in vocational education and training, all of the several types of knowledge typification appear, the objective ('know-what'), the systemic ('know-why'), the use ('know-how'), the relational ('know-who'), the creative knowledge ('care-why') (Lengyel, 2021).

"The concept of knowledge underpins the concepts of expertise, know-how and creativity, which are also widely used in regional economics to describe the creation and diffusion of knowledge. ... In regional economics, the fundamental question is:

Why can firms in less developed regions not provide the same services as firms in developed regions? After all, much of the knowledge is readily available to anyone" (Lengyel, 2021) In this research, this question was explored by reviewing the linkage between vocational education and training. The hypothesis was that the good practices collected, the innovations developed—as knowledge available to all—can be applied elsewhere with a little adaptation, taking local specificities into account.

Looking at the knowledge base of the region, it is difficult to produce knowledge in isolation, difficult to protect, not easy to store, difficult to apply in other regions, difficult to replicate and to spread in space (Lengyel, 2021). For storage, besides capturing tacit knowledge in heads, there are nowadays countless other fast and practical ways to document it, e.g., voice recordings on smart phones are now voice messages, and the use of recordings for video conferences can be a solution. For businesses, memos are an expected requirement for every event. Applicability in other regions, spatial distribution and repetition of some forms of knowledge can be solved by setting up constraints and rules.

The process description of the so-called 'SECI' (Socialization-Externalization-Co-ordination-Internalization) model (Nonaka-Takeuchi, 1995; Lengyel, 2021) presented by Lengyel for the interpretation of corporate knowledge creation, the findings formulated were confirmed by this study. Indeed, spiral steps can be used to create a growing knowledge base. Trust-based collaboration can be developed through digital techniques used in the present era, not only through face-to-face encounters, so that knowledge creation becomes increasingly global rather than local.

Deng et al. examine the relationship between leadership and innovation in Asia. They found that new knowledge from colleagues and leaders can improve individual perspectives and provide a more comprehensive understanding. Therefore, managers need to pay more attention to conflict management. Regular meetings should be organized to exchange knowledge and technological expertise to encourage knowledge sharing and innovation. Pay attention to environmental changes. Combine external and internal knowledge sharing (Deng et al., 2023).

Zada et al. investigated whether servant leadership enhances employee creativity, performance and whether knowledge sharing has a mediating role. By emphasising employee development, servant leaders foster a culture of innovation and imagination. Knowledge sharing is a link between servant leadership and employee creativity and improves individual and organizational performance (Zada et al., 2023).

According to Zheng et al., in the knowledge economy, knowledge sharing has become more important than ever for success in business. Most companies have created virtual knowledge communities, platforms for their employees and business partners in their environment to share ideas, knowledge and expertise. The use of blockchain-based tokens can be a solution to encourage low knowledge sharing efficiency (Zheng et al., 2023).

Drawing on research in the field of sport and physical education, Brasó explored the relationship between artificial intelligence and education, and the possibility of external internships. He found that the use of AI in education could enable personalization of learning. The use of technological advances (heart rate monitors, pedometers, etc.) could facilitate personalized learning that cannot be achieved today with the five senses alone (Brasó, 2023).

For training related to sport activities higher dual vocational education and training should be the link between the academic world and the world of work, through the acquisition of relevant, up-to-date and socially critical knowledge in the workplace and at university (Brasó and Arderiu, 2022).

The key players in the knowledge flow are universities and industry, where innovation is produced. This is facilitated by servant leadership, knowledge sharing and trust among staff. Technological developments bring new opportunities to implement knowledge sharing and increase the efficiency of knowledge flows. Dual vocational training is part of the knowledge sharing process in higher education.

2.2. Hypotheses

H1: Knowledge starts from the higher education institution.

It is assumed that the higher education institution has a central, hierarchical role in knowledge flows, as modelled in **Figure 2**.

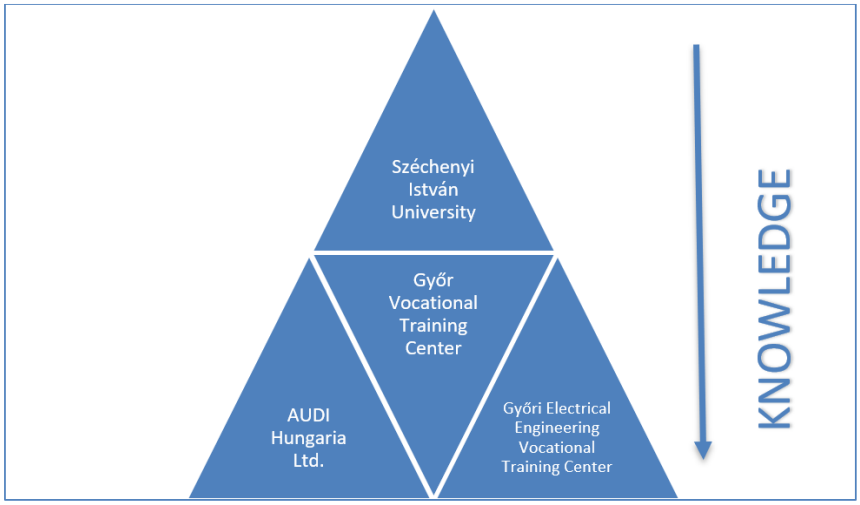

Figure 2. Hypothetical pathways and forms of knowledge flows (own research, own editing).

H2: Most “new knowledge” is generated in universities and large multinational companies.

It is assumed that the location of innovation is either the higher education institution, because it has a highly skilled workforce and research programs, or the capital-rich multinational company, which also has the human and physical resources to innovate.

H3: The university is a central actor in the knowledge flow, transferring hard and soft skills, as well as material (‘know-what’), organizational (‘know-why’), utility (‘know-how’), relational (‘know-who’) and creative (‘care-why’) knowledge (Lengyel, 2021).

It is assumed that the university is where the path of knowledge transmission starts, where it is most abundantly available. It is in higher education institutions that the flow of knowledge through organized learning, knowledge transactions, joint R&D collaborations, and interactions between actors is most widely available, in all available forms and time scales, on a regular basis. Therefore, it can be assumed that

knowledge flows in a hierarchical system start from the university towards its associated organizations.

2.3. Methodology

The research was carried out in Győr in May, June 2024, by the Chancellor of the Győr Vocational Training Center, the Director General of the Directorate General of Methodology, Digital and Teacher Training of Széchenyi István University, the Director General of AUDI Hungaria Zrt. Head of Competence Development, Vocational Training, Automation Technology, Production Technology and the Managing Director of the Győr Electrical Industry Training Center. They were interviewed in person, by telephone, as they represent the organizations. The interviewees were given the questions in advance, so that the time frame for the interview could be used more flexibly.

The research methodology is based on the analysis of selected documents of the actors studied and interviews with their representatives.

Among the documents examined were the content of the organizations' websites, previously published press releases and the content of the underlying cooperation agreements describing their joint activities and their relationship to knowledge flows. Legislation, EU, national and local regulators, and the organizations' own publicity of the regulators were examined through document analysis. From the descriptions of how the organizations work together, it is clear that they are all committed to education and knowledge transfer. The legislation mentions education as one of the tasks of each organization.

In a questionnaire survey of the organizations surveyed: The University, the Center and companies, the above-mentioned representatives were asked about the place where knowledge is created, i.e., where it comes from. Do they think there is a primary or key player in this respect? Which organization or organizations do they consider to be the place of innovation, i.e., where is new knowledge created? What type of knowledge is primarily transmitted by each actor, as listed below. From Imre Lengyel's book, do all the knowledge typologies appear everywhere and what is the most dominant, the objective ('know-what'), the systemic ('know-why'), the use ('know-how'), the relational ('know-who') or the creative ('care-why') type of knowledge.

The organizations examined were the Széchenyi István University of Győr, the Győr Electrical Industry Training Center, AUDI Hungaria Kft. and the Győr Vocational Training Center.

The aim of the study is to create a model of the knowledge transfer process between the University, the Vocational Training Center and industry. By answering the following questions. Where is the new knowledge created? Where does knowledge come from? Is there a central actor? If so, which organization?

From the legislation, regulations and documents examined, we found that according to the Vocational Education and Training Act, vocational education and training takes place in a vocational school or technical college. The first phase of vocational education is the sectoral foundation course, which lasts one year for vocational schools and two years for technical schools. This phase ends with a basic

sectoral examination. This is followed by vocational education, where, after the initial sectoral enrolment, a choice of occupation is possible in the case of the technician, both in school and in a dual training setting. A significant change compared to the previous ones is that regulation will become output-based and assessment will become outcome-based. The legislation introduces a number of new concepts and associates them with different organizations or even individuals, such as the Accredited Examination Center, the Sectoral Training Center or the Vocational Training Innovation Council.

The understanding of the Sectoral Training Center (TRC), the knowledge transfer center and dual training is important for my choice of topic. The CCI is a non-profit economic association that aims to achieve cooperation in order to meet the requirements of the dual training center. Pursuant to Article 9/F (2) of the Companies Act, the non-profit character is conferred on a company and may only be indicated in its name if its articles of association state that the profits from its activities may not be distributed among its members but must be used to increase the company's assets. The purpose of operating as a non-profit-making company is to strengthen cooperation between its members and to ensure that the profits are used for the performance of the dual training tasks. Article 81 of the Vocational Training Act defines the founding members in the context of the establishment of a Sectoral Training Center. At least four micro or small enterprises, at least two medium-sized enterprises or business organizations and the vocational training center may establish a sectoral training center with a maximum of 60% ownership. The size of the company must be determined on the basis of the SME Act. With the exception of the Vocational Training Center (which is financed from budget appropriations granted as central subsidies or budget subsidies), no more than 20% of the income of the members of the Sectoral Training Center may come from subsidies granted directly from the central budget (Kaibás, 2022).

The Győr Knowledge Transfer Center was established in 2022 as a cooperation between the Győr Vocational Training Center, Audi Hungaria Zrt and Széchenyi István University. The aim of the Knowledge Transfer Center is to make the career model based on vocational education and training more attractive and to create interoperability between vocational education and higher education by providing practice-oriented education adapted to the needs of the labor market. "The Győr Knowledge Transfer Center will create opportunities for cooperation between the corporate sector and small and medium-sized enterprises in the field of education, and will offer students new opportunities and education adapted to market needs. The cooperation will make it possible to increase the attractiveness of dual higher education and vocational training and to make efficient and optimal use of synergies and resources between the partners." (SZE News, 2022)

Dual training is a form of vocational education and training at secondary level in which vocational education and training at the institution and at labor market actors, companies and firms are provided in parallel and complementary. (Act LXXX of 2019, Government Decree 12/2020 (II. 7.)) In dual training, the student acquires practical experience at the company providing the vocational training, gets to know the company culture, and enters the labor market with competitive knowledge and experience after completing their studies.

More industry partners also provided dual training for students in schools. The organizations have recognized that their cooperation will improve their position in the market. As a result of the fourth industrial revolution, vocational education and training is dynamic and needs to adapt to changes in the labor market and to advances in science and technology. This revolution will have a major impact on the workforce, transforming jobs and requiring new skills (Arief et al., 2024). All parties mentioned know that the increase in knowledge intensity enhances the value of relationships with external partners (Tóthné and Tóth, 2021).

3. Results and discussion

The study documents the model of the knowledge transfer process between Széchenyi István University of Győr, the Győr Electrical Engineering Vocational Training Center, AUDI Hungaria Kft. and the Győr Vocational Training Center.

Based on a review of the regulators of the organizations under study, it can be concluded that in vocational education and training, including dual training, the knowledge transfer task is carried out regularly and continuously by all actors involved, in cooperation with each other.

The first hypothesis that knowledge originates from the higher education institution, was not verified. All the senior representatives interviewed agree that knowledge flows from all actors to all actors. Everyone is equal in the knowledge flow, and reciprocity and cooperation are at the heart of the relationship. In other words, the first hypothesis was refuted by the respondents. Knowledge does not come from the university, nor from the higher education institution. The manager interviewed on behalf of the higher education institution said that they work together with the organizations around them, learning from each other to achieve their common goal. Two leaders representing economic actors said that they believe that the university can be a place of connection and knowledge pooling, but it is certainly not the only place where knowledge flows downwards to other organizations. The interviewed manager of the Vocational Training Center is of the opinion that knowledge flow is a reciprocal activity. In the process of knowledge transfer, knowledge flows from everyone to everyone, both within institutions and through cooperation between institutions, as illustrated in **Figure 3**.

Figure 3. The way and form of knowledge flows (based on own research).

According to the respondents, the higher education institution does not have a central, hierarchical role in the knowledge flow, with each party flowing some knowledge to the other party in the collaboration. The result of the research is the knowledge flow model shown in the figure above.

The second hypothesis assumes that most innovation and new knowledge is generated in the university and the multinational company. There is unanimous agreement among the respondents that collaboration is the basis for innovation. New knowledge is most often the result of collaborative thinking, as multiple perspectives bring new ways of thinking, new solutions, mostly by necessity. Diversity is the source of innovation. It was also expressed by the participants in the cooperation that the higher education institution could possibly play a leading role in the linking, the clustering, the grouping and the clustering of knowledge. The representative of the University hopes that the parties interviewed will not see the University as an ivory tower, but as a partner and equal partner in the joint work. It was noted that all parties involved want to meet the needs of the labor market, with the common goal of a skilled workforce capable of collaborative thinking, cooperative working, complex problem solving, and effective personal and digital communication. The second hypothesis was refuted by all parties. It was found that "new knowledge", by which innovation is meant, is created through collaboration, as a joint result of all.

The third hypothesis—that the university is a central actor in the knowledge flow, transferring hard and soft skills, as well as material ("know-what"), organizational ("know-why"), utilitarian ("know-how"), relational ("know-who") and creative ("care-why") knowledge (Lengyel 2021)—was not confirmed by the interviewees' opinions. According to all stakeholders, all types of knowledge elements are available for everyone; the question is which one the most dominant is, which knowledge characterizes their organization the most. Therefore, the representatives of each organization would like to delimit which knowledge they have the most. In companies, knowledge of use is the primary knowledge, but there is also, of course, knowledge of objects, organizational knowledge and relational knowledge. At the university, it is material knowledge, creative knowledge and relational knowledge that are prominent in these categories. At the center, the knowledge of use, material knowledge and organizational knowledge are present. The hypothesis was not confirmed, although it could not be completely disproved. It can be argued that all the knowledge elements mentioned are present in the knowledge flows from the university, but that the university is not a central actor in this flow and that all other actors have the same knowledge elements, but to different degrees. The dual form of training ensures a continuous transmission of knowledge, not only to the participants in the cooperation, but also to the parties using the organizations. The cooperation during study provides an example of how knowledge diversification, the provision of specialized training, investment in technological infrastructure, and the development of a culture that encourages knowledge sharing and collaboration contribute to improved firm performance (Whu et al., 2024).

4. Discussion

Knowledge transfer is the responsibility of the University, schools and companies

involved in dual training. They design, manage and operate knowledge flows based on the knowledge economy, innovation and technological development. Regional knowledge creation and cross-functional links are key to everyday life. Research has shown that knowledge is a specific good, that it is indivisible in its production and consumption, that it can be easily and cheaply transferred and acquired. Its transfer is multiplied and its use can be demonstrated by the effectiveness of vocational training. These theoretical theorems also produce practical results, it can also be measured by a concrete indicator, because the fulfillment of output requirements is measured by an examination at the end of the training process, which is assessed both in percentage and numerical terms, i.e., it can be measured and thus compared.

The knowledge transfer process involves both formal and informal transfer of specific knowledge within the organization, and cooperation is based on continuous communication, which contributes to increasing organizational efficiency and effectiveness. In many cases, time and cost savings can be achieved through knowledge transfer. The availability of research development resources in the hands of individual actors and compliance with EU directives is not only a motivation but also a resource. One of the main objectives of economic policy at present is to support the knowledge economy, as illustrated by the cooperation identified.

Knowledge brokerage has an important role to play in the link between corporate social capital and corporate performance. Practical implementation of this a knowledge-sharing platform can help in this, where knowledge and experience can be shared and exchanged, and collaborations and networks of experts can be established. The use of digital tools is also important. Knowledge integration channels, internal online collaboration tools, knowledge management systems, virtual team platforms can help collaboration and knowledge sharing between departments and employees within and between companies (Quingjuan et al., 2024). The organizations studied operate a knowledge-sharing platform, which is being fine-tuned and further developed.

It is important to emphasize that this knowledge transfer process works in a specific geographical area, under specific economic and social conditions, thanks to the will and willingness to innovate of the organizations actively involved in the cooperation.

The research has shown that the knowledge transfer task is carried out regularly and continuously by the actors involved, in cooperation with each other. In the knowledge flow model, there is knowledge transfer from all actors to all actors. Knowledge does not originate from the higher education institution, as it is available and flows from all the actors involved. There is no central actor in the knowledge flow process. Innovation is collaborative and the result of joint thinking, i.e., it is not only generated in the university or in the multinational company.

The future prospects for this document are diverse. The research has also identified further opportunities and future directions. When examining collaborating organizations and networks, there are several options to choose from, what is important to focus on is the network structure, the relationship design, diversity among partners, geographical distance, other distance aspects, indirect partnership, the impact of company size, cooperation with universities, maintaining relationships, the direction of cooperation, learning capacity, number of partners (Bilicz, 2021).

The use of the local knowledge production function does not currently appear in research. Measuring the production, diffusion and application of knowledge is an exciting task, as is examining whether specialization or diversity contributes more significantly to economic growth in a given region.

The study of intra-regional knowledge flows and leakages could also be an interesting challenge for the future.

Previous research has identified the central role of the university in knowledge transfer, innovation and cooperation with industry. The present study, on the other hand, has extended the range of collaborators to include secondary vocational education actors. It also includes in its model of knowledge flows, at the same time as large enterprises, sectoral training centers, which include small and medium-sized enterprises and represent a specific form of training.

Author contributions: Conceptualization, HH and MKS; methodology, HH and MKS; formal analysis, HH; investigation, HH; resources, HH; data curation, HH; writing—original draft preparation, HH; writing—review and editing, MKS; visualization, HH; supervision, MKS. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

References

Act LXXX of 2019 on Vocational Education and Training Hungarian Official Gazette 2019. 191. https://net.jogtar.hu/jogszabaly?docid=a1900080.tv (accessed on 14.12.2022.)

Act No. V of 2006 on company registration, court proceedings and winding-up https://net.jogtar.hu/jogszabaly?docid=a0600005.tv (accessed on 14.12.2022)

Bilicz, D. (2021). A hálózatok és a kapcsolatok szerepe az innovációban és a tudás áramlásában [The role of networks and connections in innovation and knowledge flows]. Közgazdasági Szemle [Economic Review], 68(6): 674-698. https://doi.org/10.18414/KSZ.2021.6.674

Brasó, J. (2023). Inteligencia artificial (IA), transhumanismo y educación. Pensando en una e-educación fisica del future. In: López, E. Bernal C. (ed.) Educación, technologia, innovación y transferencia del conocimiento. Dykinson, pp. 405-415.

Brasó, J.; Arderiu, M. (2022). Prácticas externas y formación profesional. Familia de actividades físicas y deportivas. Revista Retos, 46: 68-75. https://doi.org/10.47197/retos.v46.91590

de Lima Figueiredo, N., Fernandes, C. I., Abrantes, J. L. (2023). Triple helix model: Cooperation in knowledge creation. Journal of the Knowledge Economy, 14(2): 854-878. https://doi.org/10.1007/s13132-022-00930-1

Deng, X., Li, J., Huang, Y., Wang, L. (2023). How Is Paradoxical Leadership Linked to Exploratory Innovation?: The Mediating Role of Knowledge Sharing and the Moderating Role of Environmental Dynamism. Journal of Organizational and End User Computing, 35(1): 1-14.

Kaibás, G. M. (2022). A szakképzési jogszabályok magyarázata [Explanation of vocational training legislation]. Budapest. https://api.ikk.hu/storage/uploads/files/szkt_kezikonyv20220316pdf-1651582395740.pdf?_gl=1*3edfy0*_ga*MjE2MTIwMzYuMTYyOTEzODY2Nw..*_ga_K4RNLHW8G3*MTczMDgyMjExMi4yMC4wLjE3MzA4MjIxMTcuMC4wLjA. (Date of download: 15.10.2024.)

Lengyel, I. (2021). Regionális és városgazdaságtan. [Regional and urban economics.] Szeged, University of Szeged Publishing House

Leydesdorff, L. (2000). The triple helix: an evolutionary model of innovations. Research Policy, 29(2): 243-255. https://doi.org/10.1016/S0048-7333(99)00063-3

Leydesdorff, L. (2005). The triple helix model and the study of knowledge-based innovation systems. International Journal of Contemporary Sociology: 42(1).

Matthies, E., Haverkamp, K., Thomä, J., Bizer, K. (2024). Does initial vocational training foster innovativeness at the company level? Evidence from German establishment data. Journal of the Knowledge Economy, 1-29. https://doi.org/10.1007/s13132-024-01756-9

Nonaka, I., Takeuchi, H. (1995). The knowledge-creating company. Oxford University Press, New York. https://doi.org/10.1093/oso/9780195092691.001.0001

Padilla Bejarano, J. B., Zartha Sossa, J. W., Ocampo-Lopez, C., Ramirez-Carmona, M. (2023). University technology transfer from a knowledge-flow approach—Systematic literature review. Sustainability, 15(8): 6550. https://doi.org/10.3390/su15086550

Rahman, W. Z. W. A., Zahari, A. S. M., Abdullah, Z. (2024). Factors Influencing Knowledge-Sharing Behavior among Academicians in Technical and Vocational Education and Training Institutions. Information Management and Business Review, 16(1): 229-238. https://doi.org/10.22610/imbr.v16i1(I).3682

The Széchenyi University, the Győr University of Applied Sciences and Audi have established the Győr Knowledge Transfer Center. SZE news, 2022.09.07. https://www.uni.sze.hu/post/a-sz%C3%A9chenyi-egyetem-a-gy%C5%91ri-szc-%C3%A9s-az-audi-megalak%C3%ADtotta-a-gy%C5%91ri-tud%C3%A1stranszfer-k%C3%B6zpontot (accessed on 15.16.2024.)

Tóthné Kiss, A., Tóth, Z. (2021). Az észak-magyarországi vállalatok innovációs tevékenységének vizsgálata, fókuszálva az információáramlásra és az együttműködésre. [Investigating the innovation activities of North Hungarian companies, focusing on information flows and cooperation.] Észak-magyarországi Stratégiai Füzetek, [North-Hungary Strategy Papers], 18: 49-60. https: //doi.org/10.32976/stratfuz.2021.4

VET 4.0 strategy. ITM, (2019). https://api.ikk.hu/storage/uploads/files/szakkepzes_40pdf-1590612271838.pdf (Date of download: 05.06.2024.)

Wismansyah, A.R., Kadir, A. R., Baja, S., Amar, M. Y. (2024). Sustainable vocational education models for industrial revolution role in development of job market absorption in Tangerang City, Indonesia. Journal of Infrastructure, Policy and Development, 8(6): 3958. https://doi.org/10.24294/jipd.v8i6.3958

Wu, J., Nachiangmai, S. (2024). Relationship between open innovation and innovation performance within high-tech firms: The mediating role of knowledge management capability. Journal of Infrastructure, Policy and Development, 8(5): 3887. https://doi.org/10.24294/jipd.v8i5.3887

Zada, S., Khan, J., Zada, M., Saeed, I., Jun, Z. Y. (2023). Does Servant Leadership Enhance Employee Creativity and Performance?: Mediating Role of Knowledge Sharing and Moderating the Role of Self-Efficacy. Journal of Organizational and End User Computing, 35(1), 1-24. DOI: 10.4018/JOEUC.321656

Zheng, K., Zhang, J. Z., Le, T. (2023). Blockchain Tokens for Enterprise Knowledge Sharing: Characteristics, Economic Ecology, and Implications. Journal of Organizational and End User Computing, 35(1), 1-20. DOI: 10.4018/JOEUC.329235

Zhu, Q., Tongkong, S. Tancho, N. (2024). Corporate social capital and enterprise performance of technology-based SMEs: The mediating role of knowledge integration ability. Journal of Infrastructure, Policy and Development, 8(1): 2726. https://doi.org/10.24294/v8i1.2726

12/2020 (II. 7.) Government Decree on the implementation of the Act on Vocational Training https://net.jogtar.hu/jogszabaly?docid=a2000012.kor (accessed on 14.12.2022)