SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2026
ORGANIZATION AND MANAGEMENT SERIES NO. 247

GOOD PRACTICES OF TECHNOLOGY TRANSFER CENTERS IN POLAND IN INDIVIDUAL PHASES OF THE INNOVATION PROCESS – QUALITATIVE ANALYSIS BASED ON IN-DEPTH INTERVIEWS

Zbigniew DREWNIAK[1], Agnieszka GOŹDZIEWSKA-NOWICKA[2*], Małgorzata MICHALCEWICZ-KANIOWSKA[3], Iwona POSADZIŃSKA[4], Urszula SŁUPSKA[5]

[1] Bydgoszcz University of Science and Technology; zbigniew.drewniak@pbs.edu.pl, ORCID: 0000-0001-8076-2942
[2] Bydgoszcz University of Science and Technology; agnieszka.gozdziewska@pbs.edu.pl, ORCID: 0000-0001-5949-3901
[3] Bydgoszcz University of Science and Technology; malgorzata.michalcewicz@pbs.edu.pl, ORCID: 0000-0003-2154-5838
[4] Bydgoszcz University of Science and Technology; iwona.posadzinska@pbs.edu.pl, ORCID: 0000-0001-8805-8255
[5] Bydgoszcz University of Science and Technology; urszula.slupska@pbs.edu.pl, ORCID: 0000-0001-6140-9713
*Correspondence author

Purpose: The aim of this article is to identify and analyze good practices used by Technology Transfer Centers in Poland in individual phases of the innovation process.
Design/methodology/approach: The study was conducted using a qualitative paradigm and individual in-depth interviews. The empirical material includes 10 interviews with representatives of technology transfer centers operating in various types of scientific institutions in Poland.
Findings: The results of the study indicate that the effectiveness of technology transfer centers largely depends on the level of professionalism of their activities, the presence of competent technology brokers, and the ability to build relationships with scientists and business partners. The most frequently identified good practices include: technology scouting and direct meetings with research teams, the use of programs supporting the improvement of TRL levels, the development of educational activities in the field of intellectual property, and the individualization of commercialization strategies depending on the nature of the technology.
Research limitations/implications: The study is qualitative and exploratory in nature, and the results obtained cannot be directly generalized to all technology transfer centers in Poland. Another limitation is the lack of triangulation of quantitative data on implementation effects.
Practical implications: The results can serve as a basis for formulating recommendations for technology transfer centers and university authorities on improving innovation support processes. Identifying good practices allows them to be adapted in other units, particularly in

the area of standardizing commercialization procedures, building a technology offering, and strengthening cooperation with business.
Social implications: The professionalization of CTT activities and increased efficiency of technology transfer can contribute to faster implementation of innovation in the economy, increased use of publicly funded research results, and a greater role for science in solving social problems.
Originality/value: The originality of the article lies in presenting the technology transfer process in phases and identifying good practices of technology transfer centers in Poland based on qualitative research. The article was produced as part of a project implemented by Bydgoszcz University of Science and Technology entitled: *Improving the process of transfer and commercialization of innovative solutions between science and the economy*, under the program "Science for Society II". The publication was financed from the state budget under the program of the Minister of Education and Science titled "Science for Society II", project no. NdS-II/SP/0235/2024/01; amount of funding: PLN 1,400.00; total project value: PLN 626,941.33.
Keywords: technology transfer centers, innovation process, best practices, commercialization of knowledge, technology transfer.
Category of the paper: Empirical article.

1. Introduction

The modern economy is increasingly based on knowledge and innovation, and the key challenge is to effectively transform scientific research results into solutions with practical market and social applications. In this context, technology transfer and knowledge commercialization mechanisms play an important role as a key element of innovation systems at the national and regional levels. Technology Transfer Centers (TTCs) operating at universities and research institutes play a special role in this process. Their task is to mediate between the scientific community and the economy and to support the implementation of R&D results.

TTCs carry out activities including the identification of the implementation potential of research, the protection of intellectual property, the building of relationships with the socio-economic environment, and the initiation of commercialization processes through licensing, the sale of rights, R&D cooperation, and the creation of spin-off companies. The functioning of these centers is thus part of cross-sector cooperation models in which economic innovation results from the interaction of science, business, and public administration.

Despite the development of instruments supporting innovation and the growing importance of technology transfer, the process of commercializing research results in Poland still faces significant barriers. One of the key problems remains the implementation gap, understood as the difficulty in moving from research to implementation and scaling of technology. Its causes include limited funding for proof-of-concept and prototyping stages, the complexity of legal regulations, insufficient managerial skills of research teams, and a weak culture of academic

entrepreneurship. Institutional barriers, such as unclear division of competences in universities and the lack of stable models of cooperation with the business environment, are also significant.

In this context, the activities of TTCs require not only the implementation of formal procedures, but also the implementation of effective organizational solutions and management tools to support innovators at subsequent stages of the innovation process. However, it should be noted that technology transfer centers in Poland are characterized by varying levels of organizational maturity, resources, and operational models, which translates into a lack of uniform operating standards. As a result, the importance of identifying and disseminating good practices that can support the professionalization of TTCs and increase the effectiveness of technology transfer is growing.

Previous analyses of the functioning of CTTs in Poland have often focused on quantitative indicators, neglecting an in-depth qualitative perspective on the practical mechanisms of these units. Meanwhile, qualitative research allows for the identification of effectiveness factors, such as the importance of interpersonal relationships, informal forms of cooperation, and management practices tailored to the specific nature of the academic environment.

Therefore, the aim of this article is to identify and analyze good practices used by technology transfer centers in Poland in particular phases of the innovation process, based on qualitative research conducted using in-depth interviews.

2. Technology transfer and the role of Technology Transfer Centers in the innovation system

Technology transfer is one of the key mechanisms that enables the effective functioning of a knowledge-based economy. In such an economy, the main source of competitive advantage is the ability to create, absorb, and implement innovations. In general terms, technology transfer can be understood as a process of moving knowledge, technical solutions, and research and development results between entities. A particularly important role is played by the flow of technology from the scientific sector to the business sector. Technology transfer includes both formal aspects, such as patent licensing, the sale of rights, or the creation of spin-off companies, as well as informal activities related to the exchange of experience, employee mobility, consulting, and project cooperation. This process is multidimensional. It includes technological, organizational, legal, and social components. As a result, its effectiveness depends not only on the quality of the technology itself, but also on institutional competences and the ability to manage relationships between stakeholders (Bozeman, 2000).

In the literature, technology transfer is often described as part of a broader process of knowledge commercialization. This process leads to the practical use of research results in the economy. Commercialization includes the identification of implementation potential, legal

protection, market evaluation, searching for business partners, and final implementation in the form of a product, service, or process technology. In this approach, technology transfer is a dynamic process. Its result is not only the transfer of technology itself, but also the creation of conditions for its further development, adaptation, and scaling. An important concept in this context is the absorptive capacity of enterprises. It determines whether an organization is able to use acquired knowledge and transform it into economic value (Markman et al., 2008).

The development of innovation systems theory shows that innovations are not created by single entities alone. They are the result of interactions between institutions forming a network, such as universities, research institutes, enterprises, and public administration. In the systemic approach, the role of intermediary institutions is strongly emphasized. These institutions facilitate the flow of knowledge and support the development of cross-sector relationships. They are especially important in countries with a relatively lower level of innovation system maturity, where communication and organizational barriers between science and business are stronger. Therefore, technology transfer should not be seen only as a technical process of transferring solutions. It should also be treated as part of an innovation infrastructure that requires proper organizational and institutional support (Lundvall, 2010).

One of the most frequently cited models explaining modern innovation mechanisms is the triple helix concept. It assumes that the development of an innovative economy results from interactions between three sectors: science, business, and public administration. This model indicates that universities no longer serve only educational and research functions (Morawska-Jancelewicz, 2016). They become active participants in economic development by creating innovations and supporting academic entrepreneurship. In this approach, universities act as entrepreneurial organizations. They generate knowledge, initiate cooperation with business, and participate in commercialization processes. The triple helix concept also highlights the importance of institutionalizing cooperation. This means creating organizational structures that enable long-term relationships between sectors (Borkowska, Zielińska, 2014).

An extension of this approach is the quadruple helix model. It also includes the role of civil society, media, and end users in the innovation process. In this model, innovations are not created only through cooperation between public and economic institutions. They also arise in response to social needs and through active involvement of users in the design and testing of solutions. The inclusion of the fourth component shows the growing importance of social, participatory, and user-oriented innovations. This also affects the way technology transfer centers operate. More often, they must integrate the perspectives of the market, society, and the environment in the process of technology assessment (Morawska-Jancelewicz, 2016).

In the innovation system, an important role is played by intermediary institutions, including Technology Transfer Centers (TTCs). These are specialized organizational units that support the commercialization of knowledge and research results. TTCs are a response to the growing complexity of technology transfer and the need to professionalize activities at the interface between science and business. Their existence results from the fact that technology creators

(scientists and research teams) do not always have competences in intellectual property law, technology marketing, business negotiations, or market analysis. Therefore, technology transfer centers act as a "bridge" between the academic world and economic practice. They reduce information, organizational, and cultural barriers (Grzyb, 2008).

The main tasks of TTCs include identifying research results with implementation potential, assessing technology readiness levels, and analyzing commercialization possibilities. In practice, this means conducting technology scouting activities. This involves actively searching for innovations in the academic environment, selecting them, and supporting their preparation for implementation (Morawska-Jancelewicz, 2016). Another key area of TTC activity is intellectual property management. This includes preparing patent documentation and supporting decisions on protection strategies. In addition, TTCs provide advisory support in developing technology offers, building relationships with industrial partners, and conducting licensing negotiations. In many cases, TTCs also support the creation of spin-off companies. They help develop business models, attract investors, and prepare documentation for funding institutions (Wiśniewska, 2012).

The literature emphasizes that the effectiveness of technology transfer centers can be evaluated both quantitatively and qualitatively. Quantitative indicators include the number of patent applications, the number of licensing agreements, commercialization revenues, and the number of created spin-off companies. However, there is increasing emphasis on the need to include qualitative factors as well. These include the level of process professionalization, the ability to support technology development at an early stage, effectiveness in building relationships with the economic environment, and the ability to create a culture of innovation within academia. For this reason, TTC activity should be analyzed from a process perspective. This approach considers their role in different phases of the innovation process (Gwizdała, Śledzik, 2017).

In Poland, the role of technology transfer centers is particularly important due to persistent systemic barriers in knowledge commercialization. Despite the development of institutional infrastructure and the increasing number of innovation funding instruments, challenges still remain. These include a low level of cooperation between science and business, limited university experience in managing technology portfolios, and insufficient use of research results in the economy. In this context, TTCs can play a stabilizing and professionalizing role. They can support universities in fulfilling their so-called third mission, which involves actively contributing to socio-economic development through the transfer of knowledge and technology (Perkmann et al., 2013).

To summarize, technology transfer is a complex process. Its effectiveness depends on the quality of cooperation between science and the economy, as well as the existence of intermediary institutions capable of managing risk, relationships, and knowledge resources. Technology Transfer Centers play a key role in this system. They connect research activities with market mechanisms of innovation implementation. Due to the growing role of universities

in a knowledge-based economy and the need to increase the effectiveness of research commercialization, the analysis of TTC functioning and the identification of effective management practices remains an important area of scientific research and practical activity.

3. The innovation process and the concept of good practices as a framework for analyzing CTT activities

The innovation process is a fundamental analytical category in research on innovation management and technology transfer. In the literature, innovations are defined as the implementation of new or significantly improved products, processes, organizational methods, or marketing methods that generate economic or social value. In this approach, innovation is not only the result of research activity. It is the outcome of a complex process that includes knowledge creation, technological development, market potential assessment, and final implementation. Therefore, the analysis of the innovation process requires a systemic and multi-stage approach. It should include technological, organizational, and market aspects (Szukalski, 2011).

In classical approaches, the innovation process was described as a sequence of stages. It started with research and development activities and ended with market implementation. Over time, it was noted that innovations do not emerge in a linear way. They are created through feedback loops between research, development, testing, and commercialization. Interactive and network models emphasize that the innovation process is dynamic. Its course depends on cooperation between many actors, such as scientists, enterprises, intermediary institutions, investors, and end users. In this context, relationships between technology creators and entities capable of implementation and scaling are particularly important (Pietras, 2013).

In research and practical applications, a phase-based approach is often used. It helps to organize the innovation process into logical stages and identify key activities within each phase. This approach is especially useful in the analysis of institutions supporting innovation, such as Technology Transfer Centers. It allows specific support instruments to be linked to specific stages of technology development. The phases of the innovation process may be defined differently depending on the adopted model. However, in the literature and technology transfer practice, the most common approach includes the following stages: idea generation, technology development, intellectual property protection, commercialization, and market implementation (Rogers, 2003).

The first phase of the innovation process is the identification and generation of innovative ideas. This stage includes the creation of new technological concepts and the identification of research results with application potential. The literature indicates that innovation sources may come from research activity, market needs, user observations, and cooperation with enterprises.

It is particularly important to identify a real market problem that can be solved using the scientific potential of a university. In this context, the importance of user-oriented approaches and open innovation concepts is increasing. In such models, enterprises and scientific institutions co-create solutions by sharing knowledge and resources (Piecuch, 2020).

The second phase of the innovation process is technology development and prototyping. It includes activities aimed at increasing the technology readiness level and adapting the solution to market requirements. This stage involves high technological and financial risk. It requires investments in industrial research, development work, and validation tests. The literature highlights the importance of instruments supporting the transition from the laboratory phase to the demonstration phase. This transition is often described as the "valley of death" of innovation. It is a moment when the technology has potential but lacks resources for further development. In this area, tools for assessing technology readiness levels are particularly important. They allow progress to be monitored and further stages of development to be planned (Klimczuk, 2021).

The third phase of the innovation process concerns intellectual property protection. This is one of the key conditions for successful technology commercialization. From a strategic perspective, intellectual property is a resource that creates competitive advantage. It protects research results from unauthorized use. IP protection includes patents, utility models, trademarks, and know-how. The choice of the appropriate protection form depends on the nature of the technology, its market potential, and the implementation strategy. The literature indicates that effective intellectual property management requires not only legal competence. It also requires the ability to assess the value of a technology, its novelty, and its possible applications in specific economic sectors (Piecuch, 2020).

The next phase of the innovation process is commercialization. It is understood as the process of introducing technology into economic practice through the transfer of rights, product implementation, or the creation of a new business entity. Commercialization may take different forms. These include licensing, selling intellectual property rights, joint ventures with enterprises, providing research and development services, and creating spin-off companies. The literature emphasizes that commercialization success depends not only on the quality of the technology. It also depends on the ability to develop a business model and adapt the solution to market needs. In this context, value creation and value capture are particularly important. They determine whether technology implementation is profitable for both the creators and the implementing enterprise (Klincewicz, 2016).

The final phase of the innovation process is implementation and market development of the technology. This phase includes scaling, adapting the product to user requirements, and further improvement. In this approach, innovation does not end when a licensing agreement is signed or when the technology is sold. It requires continuous improvement, monitoring implementation effectiveness, and developing cooperation between the parties. The literature indicates that innovation implementation is often a long-term process. It depends on

an organization's ability to manage change, introduce new production and organizational processes, and build market competences. A dynamic approach is particularly important here. It treats innovation as a cycle of learning and adaptation to changing economic conditions (Rogers, 2003).

In the analysis of Technology Transfer Centers, the phase-based approach to the innovation process is especially useful. It helps to organize TTC activities according to logical stages of technology development and assign specific support functions to each stage. Technology transfer centers can participate in the innovation process at every phase. This includes idea identification and technology scouting, advisory support in obtaining funding and increasing TRL, preparation of patent documentation, development of commercialization strategies, and support in business negotiations. This role of TTCs goes beyond the traditional view of technology transfer as a simple handover of a solution. It includes comprehensive management of the implementation process (Pietras, 2013).

An important element of TTC activity analysis is also the concept of good practices. Good practices are understood as proven and effective organizational, procedural, or operational solutions. They increase the effectiveness of institutions and can be replicated in other organizations. Good practices represent a form of organizational learning and management knowledge transfer. They help institutions improve performance by adapting solutions developed by leaders in a given industry or sector. Management literature indicates that identifying good practices is particularly important in organizations operating under high uncertainty. In such conditions, there are no clear standards, and effectiveness depends on experience, competences, and the quality of internal processes (Rogers, 2003).

The analysis of good practices in TTC activity is especially important because these centers operate in an environment characterized by high technological diversity, varied stakeholder expectations, and institutional limitations resulting from legal and organizational conditions at universities. As a result, technology transfer processes are rarely fully repeatable. Their effectiveness depends on the ability to flexibly adjust tools to the specific technology and industry. At the same time, the literature indicates that some process elements can be standardized. This increases transparency and operational efficiency and supports commercialization decision-making. Therefore, good practices are an important reference point for building TTC operating models. They help identify solutions that reduce risk, shorten implementation time, and increase the chances of successful commercialization (Perkmann et al., 2013).

The innovation process provides a useful analytical framework. It allows the systematization of activities carried out by technology transfer centers and supports the evaluation of their effectiveness at different stages of technology development. At the same time, the concept of good practices makes it possible to identify and compare organizational solutions used by TTCs. It also helps indicate actions that can be considered particularly effective under institutional conditions typical for the Polish innovation system. The use of

a phase-based approach combined with good practice analysis supports a deeper understanding of the role of TTCs in technology transfer. It also provides a basis for developing recommendations aimed at the professionalization of these units.

4. Research methodology

The study was conducted within a qualitative research paradigm. Its aim was to gain an in-depth understanding of organizational phenomena, processes, and institutional mechanisms. This was done by analyzing the experiences, opinions, and practices of people directly involved in the studied area. A qualitative approach is particularly appropriate when the subject is complex and strongly context-dependent. It is also useful when the goal is not to test statistical hypotheses, but to identify patterns of action and interpret the meanings that participants assign to specific practices. In the case of Technology Transfer Centers (TTCs), organizational conditions, institutional differences, and varying levels of maturity of technology transfer structures make qualitative research an adequate tool. It allows the reconstruction of innovation support mechanisms and the identification of good practices.

The study used in-depth individual interviews (IDIs). This method made it possible to obtain detailed information about procedures, tools, and operational activities related to technology transfer and the commercialization of research results. In-depth interviews support exploration of the respondents' perspectives. They help identify success factors and organizational barriers. They also provide examples of specific solutions used in institutional practice. The use of IDIs is particularly justified in research on TTC activities. Many technology transfer processes are informal and relationship-based. Their effectiveness depends on experience, competences, and the institutional context.

The study had an exploratory and diagnostic character. On the one hand, it focused on how technology transfer centers operate in Poland. It also examined solutions used in subsequent phases of the innovation process. On the other hand, it enabled a diagnosis of the practices most often perceived by respondents as effective. It also pointed to areas that require further development. The exploratory approach captured the diversity of TTC activities. It also identified elements that can serve as a basis for a national good practice model. In total, 10 in-depth individual interviews were conducted with representatives of technology transfer centers operating in Poland. The sample was selected purposively. The key assumption was to maximize institutional diversity. This made it possible to capture different organizational and operational models used by technology transfer units.

The selection included TTCs operating within large research universities, as well as centers from regional universities and research institutes. Including institutions of different scale and profile helped identify good practices typical for different types of scientific institutions and different technology sectors.

The selection of technology transfer centers was based on a set of effectiveness criteria. These included, among others: the scale of commercialization, the number of signed licensing agreements, the number of established spin-off/spin-out companies, revenues from commercialization, the intensity of educational and advisory activities, the length of time the unit has been operating, membership and activity in the PACTT network, the level of internationalization, the quality of intellectual property protection, financial efficiency, and recognition in the science–business community. These criteria supported the selection of units with an established position in the national technology transfer system, as well as smaller and developing centers.

The respondents held key roles within technology transfer structures. They included TTC directors, technology brokers, commercialization specialists, and technology transfer experts. This group was chosen because they have practical knowledge of innovation implementation mechanisms, business negotiations, and the management of intellectual property protection processes.

To present the sample characteristics in an orderly way, the article includes a list of institutions together with respondent roles and interview dates (Table 1).

Table 1.
Characteristics of the research sample (TTCs included in the qualitative study)

Institution / unit	**Type of entity**	**Respondent role**	**Interview date**
Maria Curie-Skłodowska University in Lublin	university	TTC director	07.05.2025
Wrocław University of Science and Technology	technical university	TT expert	13.06.2025
Wrocław University of Economics	economics university	center director	12.06.2025
University of Warsaw	university	acting deputy director	12.06.2025
Kazimierz Wielki University in Bydgoszcz	regional university	center director	26.06.2025
University of Wrocław	university	acting deputy TTC director	12.06.2025
Warsaw University of Life Sciences (SGGW)	agricultural university	TTC director	03.07.2025
Medical University of Gdańsk	medical university	acting TTC director	04.07.2025
Institute of Horticulture – InHort	research institute	head of TT team	07.07.2025
Poznań University of Technology	technical university	TTC director / special-purpose company director	09.07.2025

Source: author's own work based on the study documentation.

The research tool was an original in-depth interview guide. It was designed to identify good practices used by technology transfer centers across successive phases of the innovation process. The guide was semi-structured. It included a set of key research questions and thematic

areas. At the same time, it allowed deeper exploration of topics important to respondents. The structure was based on a phase approach to the innovation process and covered the following areas:

- identification and generation of innovative ideas (e.g., scouting, networking activities, cooperation with business, market potential assessment),
- technology development and prototyping (support in increasing TRL, obtaining funding, cooperation with laboratories and industrial partners),
- intellectual property protection (IP identification procedures, cooperation with patent law firms, education on rights protection),
- commercialization (commercialization procedures, licensing models, spin-off/spin-out, technology marketing tools, negotiations),
- technology development after commercialization (monitoring implementation outcomes, support in scaling, obtaining funding),
- cooperation and exchange of experience (relations with other units, international inspiration, unique features of a given center).

This structure enabled the collection of comparable data across units. It also supported a process-based analysis of TTC activities, consistent with the adopted theoretical framework.

The in-depth interviews were conducted between May and July 2025. Each interview followed the same guide. This ensured comparability of the collected data. At the same time, the approach allowed flexibility to develop new threads that emerged during the conversation.

Due to the specificity of the respondent group and organizational constraints related to the availability of TTC managers and experts, interviews were conducted either face-to-face or remotely (online). The interviews usually lasted between about 45 and 90 minutes. This made it possible to gather detailed information on operational processes and examples of specific implementation activities.

Data were collected in the form of research notes and structured interview sheets. The respondents' answers were recorded according to the thematic structure of the guide. To ensure research reliability and data consistency, the same documentation structure was used for each interview.

5. Research results – good CTT practices in the phases of the innovation process

The analysis of the empirical material collected through ten in-depth individual interviews showed that the activities of Technology Transfer Centers (TTCs) in Poland differ significantly in terms of organization and procedures. However, it was possible to identify a set of recurring good practices that appeared in most of the analyzed units. Respondents emphasized that the

effectiveness of technology transfer does not result only from formal procedures. It depends mainly on the ability to build relationships with researchers and on the capacity to actively manage the innovation process from the early idea stage to commercialization.

The research results also indicate that the best practices of TTCs can be organized according to a phase-based model of the innovation process. This structure makes it possible to capture the specific activities carried out by centers at each stage. It also shows how organizational instruments and support tools are adjusted to the level of technology maturity.

The most frequently indicated good practice in the first phase of the innovation process was technology scouting. It was understood as active outreach to researchers and research teams in order to identify research results with application potential. Respondents emphasized that in universities and research institutes, innovations are rarely reported spontaneously. Therefore, the proactive attitude of TTC brokers and specialists plays a key role.

This practice mainly involved direct meetings with researchers, one-on-one conversations, and monitoring ongoing research projects. One respondent stated that "one-on-one conversations with researchers are the most effective", because scientists are often willing to talk about their work. This makes it easier to identify solutions with implementation potential. A similar view was expressed by respondents from Wrocław University of Science and Technology. They highlighted the importance of direct meetings and systematic support already at the stage of research project planning. In research institutes, a slightly different approach was observed. Innovation identification was more strongly linked to relationships with industry. A representative of the Institute of Horticulture pointed out that idea generation most often takes place through direct contact with business, especially during discussions about the needs and challenges of entrepreneurs.

The second key practice in the identification phase was the organization of matchmaking meetings and initiating contacts between researchers and representatives of the business sector. This practice was particularly developed in units with access to international cooperation networks. In the case of the Medical University of Gdańsk, respondents emphasized the importance of participation in international matchmaking initiatives, including those organized within EIT Health. They noted that such meetings allow research ideas to be verified and increase the chances of technology development in partnership with business. In other units, matchmaking was often local and regional. It focused on building relationships with enterprises operating in the direct environment of the university. An example is Kazimierz Wielki University in Bydgoszcz. Respondents stated that the center mainly analyzes the market needs of local companies and public institutions and then initiates meetings to identify potential areas of cooperation.

Another practice identified in the study was the organization of professional community events, such as conferences, debates, workshops, and science-to-business initiatives. Respondents emphasized that these activities serve two purposes. First, they promote research

results. Second, they create space for interdisciplinary cooperation and allow ideas to be confronted with a business perspective.

At Kazimierz Wielki University in Bydgoszcz, respondents stated that organizing debates and conferences allows researchers from different disciplines to present their results and build potential for interdisciplinary cooperation. At the same time, it enables business representatives to assess the ideas. Similar activities were carried out by the TTC of Poznań University of Technology. Respondents highlighted participation in industry and trade fairs as a tool for identifying new cooperation areas and as an impulse for developing commercial projects.

The analysis of the empirical material showed that the assessment of the market potential of ideas is not always formalized. In some units, there were no formal selection procedures. Decisions were made based on the experience of the TTC team. An example is the University of Warsaw. Respondents stated that there are no unified evaluation procedures, and the assessment is based mainly on the individual expertise of TTC employees. The situation was different at the Medical University of Gdańsk, where the initial technology assessment is conducted using the TRL model and the IRL model (KTH IRL), as well as consultations with industry experts. At Wrocław University of Science and Technology, a stage-based approach was described. It includes initial screening of research results using criteria such as ownership rights, innovativeness, and market demand. This is followed by a more detailed analysis of commercialization potential. In practice, this solution can be considered a good practice for early elimination of projects with limited implementation chances.

Respondents emphasized that researchers' willingness to report innovations depends strongly on motivation mechanisms and on raising awareness of the benefits of commercialization. The most frequently mentioned activities included training sessions, information campaigns, practical guides, and the promotion of implementation success stories. At Wrocław University of Science and Technology, respondents stated that educational activities and presenting successful case studies are effective motivational tools. They strengthen the belief that commercialization is realistic. The Medical University of Gdańsk emphasized the role of advisory support in preparing patent applications. It also highlighted the promotion of successful implementations as a mechanism encouraging researchers to report solutions.

In the second phase of the innovation process, respondents indicated that the main challenge is securing funding for development work, prototyping, and proof-of-concept activities. The most frequently mentioned good practice was the use of systemic public funding programs, such as Inkubator Innowacyjności (+, 2.0, 4.0) and Science4Business – Inkubator Rozwoju. An expert from Kazimierz Wielki University emphasized that these programs enabled pre-implementation work. They also supported technology promotion and preparation for market entry. Similar experiences were reported at Maria Curie-Skłodowska University. There, Inkubator Innowacyjności was used to identify research results with commercial potential, support researchers in planning prototyping activities, and provide administrative and

commercialization support. At the Medical University of Gdańsk, respondents also noted the possibility of obtaining funding through IDUB programs and innovation incubators financed by the Ministry of Science and Higher Education. This made it possible to carry out development and prototyping activities with TTC support.

The interview analysis showed that effective management of pre-implementation projects requires the use of project management tools, as well as schedules and milestones. At Maria Curie-Skłodowska University, respondents stated that good results come from stage-based work and team-based project supervision. This includes the involvement of an R&D expert, a patent attorney, a broker, and a project specialist. A similar approach was described by the Medical University of Gdańsk. Respondents emphasized the importance of integrated project management and systems for monitoring R&D progress, including schedules and milestones. This practice allows better control of the technology development process and reduces the risk of projects being stuck at the prototype stage.

Respondents also emphasized the importance of cooperation with industrial partners already at the concept stage. Maria Curie-Skłodowska University indicated that close cooperation with a business partner at an early stage is one of the most important success factors in technology development. A similar approach was presented by InHort. A key practice was searching for partners among industry companies cooperating with the institute and identifying funding sources for development work.

The results show that intellectual property protection is one of the most developed TTC functions. However, differences were also observed in the level of formalization. At Maria Curie-Skłodowska University, respondents pointed to mandatory reporting of results with commercialization potential as a good practice. They also highlighted cooperation with a patent attorney combined with an assessment of the market uniqueness of the solution. An important part of the study was the comparison of cooperation models with patent attorneys. Respondents stated that having an internal patent attorney ensures better availability and more efficient information flow. In contrast, cooperation with an external law firm may extend the process and limit direct contact between researchers and the expert.

A representative of the University of Wrocław stated that after switching to an external law firm model, researchers lost direct contact with the patent attorney. The center was forced to act as an intermediary, which extended the process and created additional organizational workload. At the same time, the respondent noted that in some universities cooperation with an external law firm may work well. However, in the analyzed unit the internal model was considered more effective. At Maria Curie-Skłodowska University, an opposite problem was observed. The patent attorney employed by the university was not interested in cooperation with the TTC. This limited the possibility of involving the attorney in commercialization at an early stage. This result indicates that the mere presence of an internal patent attorney is not sufficient. What matters is the integration of the attorney into TTC processes.

In the commercialization phase, respondents emphasized the importance of actively building a technology portfolio and preparing a professional offer for external partners. One good practice was developing industrial and investor contact databases and participating in industry fairs to attract potential licensees. The Medical University of Gdańsk indicated that contact databases, participation in international fairs (e.g., MEDICA), and technology presentations to venture capital funds are effective tools. Interview analysis confirmed that the most effective commercialization forms are licensing agreements and the creation of spin-off companies. Respondents emphasized that licensing is particularly effective when the technology is well defined and can be implemented quickly by a company. Spin-offs are preferred when the technology requires further development and investment funding. The Medical University of Gdańsk stated that the most effective solutions are licensing agreements and spin-offs involving the inventors. Respondents also noted the growing importance of joint development agreements with foreign venture building entities. One example of a successful practice was a spin-off based on a diagnostic technology. It obtained seed funding and started clinical trials as well as the hospital exemption process.

Respondents also indicated that commercialization requires flexibility and adjustment to the specific nature of the technology. At the University of Wrocław, it was emphasized that fully standardized procedures do not exist. The center uses common elements such as market analysis, freedom-to-operate analysis, and partner identification, but each project is treated individually. In contrast, the Medical University of Gdańsk reported the existence of internal commercialization procedures. These include IP valuation, market analysis, risk assessment, and negotiations of licensing and sales agreements. This result shows that standardization can be effective in units with greater experience and organizational resources. In smaller centers, a flexible model is more common.

The interview analysis showed that the implementation and market development stage is the weakest element of TTC activity in Poland. Respondents stated that support after signing a licensing agreement or selling rights is often limited. Centers mainly focus on reaching the contract stage. Representatives of the Medical University of Gdańsk stated that post-commercialization support is provided only to a limited extent in the case of licenses. In the case of spin-offs, the center does not directly engage in market activities. The University of Warsaw declared readiness to support inventors also after commercialization if needed. This support may include marketing activities and preparation of grant applications related to IP protection and commercialization strategy. At the same time, respondents emphasized that limitations in developing this phase result mainly from a lack of staff resources and the absence of formal tools for monitoring implementation. Therefore, the post-commercialization stage remains an area requiring further development. It may also become an important direction for the professionalization of technology transfer centers.

6. Conclusions

The most frequently identified good practices of Technology Transfer Centers included active technology scouting and direct relationships with researchers, the use of a stage-based approach to technology development (milestones and schedules), obtaining funding for proof-of-concept and prototyping activities (e.g., Inkubator Innowacyjności, Inkubator Rozwoju), as well as the professionalization of intellectual property protection and commercialization processes through negotiation support and legal-business advisory services. Respondents also highlighted the importance of educational and promotional activities, which strengthen the culture of innovation and motivate inventors to report research results with implementation potential.

At the same time, the study revealed significant differences between the analyzed TTCs. These differences resulted from the level of organizational maturity, available human resources, and adopted operational models. Some centers relied on standardized procedures and formal technology assessment tools (e.g., TRL), while others operated in a more flexible way, based on team experience and an individual approach to each technology. Differences were also observed in the organization of IP support, including access to patent attorneys and the level of TTC involvement in the implementation phase and post-commercialization market development after signing commercialization agreements.

The research results confirm that TTCs play a strategic role in the innovation system as intermediary institutions between science and the economy. They reduce the implementation gap and strengthen the ability of universities and research institutes to use research results in practice. The effectiveness of TTCs directly contributes to increased efficiency of knowledge commercialization, the development of academic entrepreneurship, and the building of long-term relationships with the business sector. This is an important element of competitiveness in a knowledge-based economy.

References

1. Borkowska, S., Zielińska, E. (2014). *Układ otwarty. Miejskie partnerstwa międzysektorowe.* Warszawa: ResPublica, p. 68.
2. Bozeman, B. (2000). Technology transfer and public policy: a review of research and theory. *Research Policy, Vol. 29/4,* p. 635.
3. Grzyb, U. (2008). Centra transferu technologii jako czynnik rozwoju gospodarki opartej na wiedzy. *Przedsiębiorczość – Edukacja, no. 4*, p. 74.

4. Gwizdała, J.P., Śledzik, K. (2017). Responsible Research and Innovation in the Context of University Technology Transfer. *Acta Universitatis Lodziensis. Folia Oeconomica, Vol. 2, no. 328*, p. 57.
5. Klimczuk, A. (2021). *Innowacje — od pomysłu do praktyki*. Warszawa: PWN, p. 56.
6. Klincewicz, K. (2016). *Zarządzanie, organizacje i organizowanie – przegląd perspektyw teoretycznych.* Warszawa: Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego, p. 253.
7. Lundvall, B. (2010). *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning.* Anthem Press, p. 231.
8. Markman, G.D., Siegel, D.S., Wright, M. (2008). Research and Technology Commercialization. *Journal of Management Studies, Vol. 45/8*, p. 1403.
9. Morawska-Jancelewicz, J. (2016). Model poczwórnej helisy jako narzędzie wdrażania strategii inteligentnych specjalizacji. *Gospodarka Regionalna i Międzynarosowa, no. 46,* p. 109.
10. Perkmann, M., Tartari, V., McKelvey, M., Autioa, E., Broströmc, A., D'Este, P., Finif, R., Geuna, A., Grimaldif, R., Hughes, A., Krabel, S., Kitsong, M., Llerenai, P., Lissoni, F., Salter, A., Sobrerof, M. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. *Research Policy, 42*, p. 424.
11. Piecuch, T. (2020). *Zarządzanie procesem innowacyjnym w organizacji.* Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, p. 49.
12. Pietras, P. (2013). Bariery współpracy przy wdrażaniu innowacji w organizacji sieciowej na styku sektora przedsiębiorstw i B+R. *Organizacja i Zarządzanie: kwartalnik naukowy*, *No. 4(24),* p. 129.
13. Rogers, E.M. (1983). *Diffusion of Innovations.* New York: Divison of Macmillan Publishing, p. 175.
14. Szukalski, S.M. (2011). Innowacje w zarządzaniu centrami usług wspólnych. *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Ekonomiczne Problemy Usług, no. 64*, p. 139.
15. Wiśniewska, S. (2012). Budowa współpracy nauki z gospodarką wyzwaniem dla polityki innowacyjnej państwa. *Ekonomia, no. 245*, p. 634.