Comparison of selected aspects of the technology transfer in Poland, Turkey, and Serbia

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Abstract

This paper provides insight into technology transfer offices while drawing comparisons among Poland, Turkey, and Serbia. It assesses the level of development achieved by each country in enhancing the activities of their technology transfer offices. This review employs a qualitative approach. Data were sourced from monographs, research papers, articles, and abstracts using electronic searches. Qualitative insights on TTO activities and objectives were obtained from relevant articles and government publications. The findings reveal notable disparities among these nations concerning their motivations for technology transfer, the consistency of their regulations, the industrial uptake of their innovations, and their overall objectives. The results show that Poland emerges as a leader in technology transfer, while Turkey faces budget constraints, relying primarily on government funding. In Serbia, fostering collaboration between local and international stakeholders is identified as vital to strengthening the performance of Serbian TTOs. This study advances the understanding of technology transfer offices by examining their activities, challenges, societal impact, and

funding mechanisms in Poland, Turkey, and Serbia. By comparing these contexts, it enhances theoretical insights into factors influencing TTO effectiveness, offering valuable contributions to the field. Additionally, the study utilizes data on global innovation indexes and patent numbers from 2013 to 2020.The findings of this study offer practical insights for policymakers and stakeholders in technology transfer. By highlighting variations in TTO activities and challenges across Poland, Turkey, and Serbia.

Key words

technology transfer office, industry-university relationship, research and development center, intellectual property, Poland, Serbia, Turkey

Introduction

The rising effect and the importance of novel technology on people are addressed in the standards of living, such as economic development, improved prosperity and communication, educational accessibility, and environmental sustainability. Nowadays, technology and its transfer processes are gaining importance. Both sourcing and transferring technological solutions offer greater opportunities for the development of modern enterprises.

Many agree with the theory created in the first half of the twentieth century by Josef Schumpeter, which states that entrepreneurship is the main driver of innovation and a catalyst for technological change in the economy [Schumpeter, 1976]. In the process of evolution, innovation is developed and commercialized based on entrepreneurial activity, which encourages economic growth. The product evolution process can begin with basic scientific information that is, in the end, responsible for the creation of services and products available on the market. The main problem of technology transfer (TT) arises at this very point - the harmonization of technology with the target market.

Even though many scholars have studied and developed the definition of technology, they all still revolve around the same meaning that it is a human-made framework that utilizes information and organization to generate materials and processes to achieve certain objectives [Carroll, 2017]. Most academics have agreed that technology transfer is strongly related to the transfer of information, understanding, and technical expertise represented in products, processes, and management, based on multiple criteria from diverse areas of research and background [Wahab et al., 2011]. One study has suggested that the definition of technology transfer can be considered to be the practice of transferring diverse kinds of technologies from one person or

group to the next in techniques that suit the business requirements or community [Sudha Rani et al., 2018]. Technology transfer is narrow and broadly defined. Poland has no one specific definition of technology transfer. Each organization is responsible for following and applying the general objectives and aims of the technology transfer centers. Polish legal acts do not define technology transfer, the act on Higher Education Law says that technology centers can be established by higher schools. This act of law regulates the aims of Technology Transfer Offices (TTOs) and the forms of those centers. But the definition of technology transfer in Turkey was established by the cooperation of the two main responsible parties for registering and handling intellectual properties in Turkey which are The Turkish Scientific and Technological Research Council (TÜBİTAK), and the Ministry of Industry and Technology mainly described the technology transfer as a successful adaptation of advanced technology to one or more organizations in line with their needs. The transferred technology can be considered an innovation for the buyer or buyers [TTO, 2020]. The TT activity needs at least one receiver and one transmitter, a transfer that may be initiated by the source, the recipient, both together, or by third parties. In TÜBİTAK, simple and exclusive licenses, transfer, and partnership capital methods are adopted and encouraged to be the transfer methods made by the authorities to the third parties in the intellectual property rights owned or partnered by the authority [Education, 2018].

Article 25c of the Law on Innovation Activity of the Republic of Serbia defines the Technology Transfer Center (CTT) as follows: Technology Transfer Center is a corporate law established exclusively to perform technology transfer activities for the application of technological innovations, which includes, in particular, the search for ideas and partners for technology transfer, assessment of the commercial potential of transfer, incentives for realization and commercialization of technology transfers and assistance in the protection of intellectual property to technological companies that develop, produce and sell innovative products, processes, and services with a high level of know-how and new technologies. The Minister shall prescribe the conditions regarding the necessary program, spatial and professional capacities under which a legal entity may be entered in the Register as a technology transfer center, as well as regarding the conditions under which it shall be deleted from the Register [Official Gazette of RS, 2021].

Considering the tripartite relationship between university, industry, and government that has a significant impact on economic growth, and university-industry cooperation is difficult, but it is one of the most beneficial technology transfer methods for national development.

Potential collaboration in technology development between Turkey- Poland, and Serbia- Poland has encouraged us to define the importance and draw attention to the relationship between these countries to help the students, researchers, and other public and private entities to understand the general idea of the Technology Transfer Office (TTO) in these counties and the most important differences and similarities. The continuously increasing international cooperation in the research and development (R&D) sector between the three countries was mainly an encouraging purpose to start this study, numerous recent projects and calls were carried out by the collaboration of these countries which will increase the number of students and researchers to look and be involved in developing their projects under TTOs.

To achieve the article's aim of offering the latest fulfilled developments by the TTO a detailed comparison of studied countries was included in this study.

The structure of the study included the literature review first, followed by the research method and hypothesis analysis, then the research results included the comparison of the following aspects: a general comparison of the main role and process, the funding entities, the main obstacles, the main agent, the transfer medium and the transfer object of the TTOs. In addition, the funding entities and the main scope of activities were further elaborated, as well as exemplary projects. Lastly, some conclusions and important recommendations were given to develop the TTOs activities of the three studied countries.

1. Literature review

Reviewing many scholars, most researchers have defined and analyzed the definition of TTO of their countries as well as examining various stages of the process and indicators associated with the TTO, some of them have mentioned the evaluation of the TTO in each country, [Jarzynowski, 2020] has described and examined the role of technology in Polish enterprises by studying the different forms of intellectual property, that are designed and developed in Poland. Çiftçi [2017] has thoroughly studied the importance of measuring the performance of the Turkish TTO alongside the contribution of the TTO to public benefit and socio-economic development of the country, a collection of measures was proposed and developed by the paper as a useful and systematic performance evaluation standard.

Güler and Kirbaşlar [2020] had studied the effect of TTOs on innovation-centered entrepreneurship and intellectual industrial property rights in Turkey has been examined, the importance of TTOs in terms of university-industry cooperation, their contribution to entrepreneurship, and their contribution to the development of intellectual industry property rights were discussed thoroughly in his book.

Other types of studies have compared the TTO of different countries, Decter, Bennett and Leseure [2007] for an instance, have analyzed the differences and similarities, and examined the issues in university to business technology transfer in the US and UK. By learning more about how technology transfer specialists saw the relationship between university and industry, they were better able to identify the obstacles to this process and provide potential solutions in their work.

Wahab, Rose and Osman [2011] have provided an in-depth discussion of the term 'technology' itself and analyzed it from various perspectives, research backgrounds, and disciplines. They thoroughly examined the history, explanations, and notions of technology and technology transfer. Etzkowitz and Zhou [2021] have described technology transfer and academic entrepreneurship at Stanford University, including venture creation, of an iconic entrepreneurial development.

Another article that was published in Poland by Haudeville, Dabic and Gorynia, [2002] about the difference of TT in East Europe discussed the reasons for the low impact of transition economies in East Europe and added some examples of limited local capacities of Croatia, alongside the situation in Hungary with their institutional responses and the high added value on the production of TTO, lastly, they discussed the situation in Poland as well and compared it with both examples.

From another perspective of view, Damijan et al. [2005] have studied the impact of foreign direct investments in more than 8000 firms in the ten most advanced countries in technology transfer and noted and contained the impact on the growth of productivity after utilizing different channels of technology transfer which are the direct transfer of technology through international licensing, the foreign direct investment and the transfer through international trade.

An article written by Salamonowicz [2018] contains updated and developed research findings from the National Research Centre of Poland-funded project. The research's conclusions indicated a variety of technology transfer models, with a typology based on the university's company's existence and its connections to TTOs, as well as the legal standing of patent attorneys, technology brokers, and legal counsel.

Another international study done by Pronay et al. [2022] has discussed the advanced knowledge of the variables affecting the efficiency of university TTOs in Europe and Japan's departments that are tasked with assisting the commercialization of research ideas. The research has shown that a TTO's marketing skills and social embeddedness have an excellent impact on performance. Strict patent portfolio management has a negative influence on European TTOs' performance but has no discernible impact on TTO performance in Japan.

The article that is written by Łącka [2013] presented the importance of cooperation to raise the rank of economic innovativeness and competitiveness. It discussed the significance and advantages of technical collaboration between Polish academic institutions, businesses, and government agencies for the inventiveness and economic competition of businesses. The study was done using the findings of the author's investigation into the technical collaboration between researchers and businesspeople in Poland between 2004 and 2011.

Improvement of Turkish TTOs was studied in Ustundag, Uğurlu and Kilinc, [2011] article, they found that the demand for industry research, university R&D budgets, TTO personnel resources, and economic instability are the elements that have the biggest effects on TTO success. The factors, licenses, patents, well-established spin-offs, industrial research contracts, and consulting income are the performance outputs that are most impacted.

All these articles and studies have discussed TTOs from one point of view or have compared different aspects of TTO in different countries. Nevertheless, none of them has studied TTO in the three countries that are mentioned in this article. Moreover, the literature review did not result in any article that discussed and compared the aspects that are mentioned in this article. This study emphasizes the importance of institutional and inter-organizational considerations in the TTO's performance. In addition, it is one of the few studies in the field of university-industry collaborations to be conducted across multiple continents (Europe and Asia), which contributes to a greater understanding of the region's contingent roles that have so far gone unexplored because previous studies were typically only conducted in one nation.

2. Research methodology

This article was written to present the differences and similarities between the TTOs in the declared three countries to introduce students, researchers, or any other interested entities to the basic information of TTOs. The indicators of these comparisons and potential future expectations for Polish, Turkish, and Serbian TTO were determined by defining and comparing existing national structures.

Article selection was made by searching for examples of international cooperation of TTOs, the importance of supporting small businesses, and projects of TTOs for the socio-economic development of the countries.

A qualitative methodology is used in this literature review as it drew data from monographs, research papers, published articles, and abstracts. The data mainly were collected through electronic searching methods. The statistical data were collected

from recent studies that mentioned and gathered quantitative facts as the main purpose of the article, the other qualitative data related to the information about the activities, scoop, and objectives of TTOs were established by reviewing the related articles and official papers that were published by governmental entities of each country. Further studies were chosen by examining the reference lists of all included articles. The following keywords were used: "Technology Transfer", "University-Industrey relationship", "International cooperation", "Intellectual property", "Patent" or "Research and Development Center". Articles published after 2010 were preferred. Articles written in English, Turkish, Polish, and Serbian languages were examined.

This study identified 99 articles that were evaluated for eligibility by 2 independent reviewers. In the first stage, titles and abstracts were scanned. This resulted in a final selection of 30 articles, all of which were reviewed in a second phase. The final selection was made using the inclusion criteria of choosing the references in this article, summarized in Figure 1.

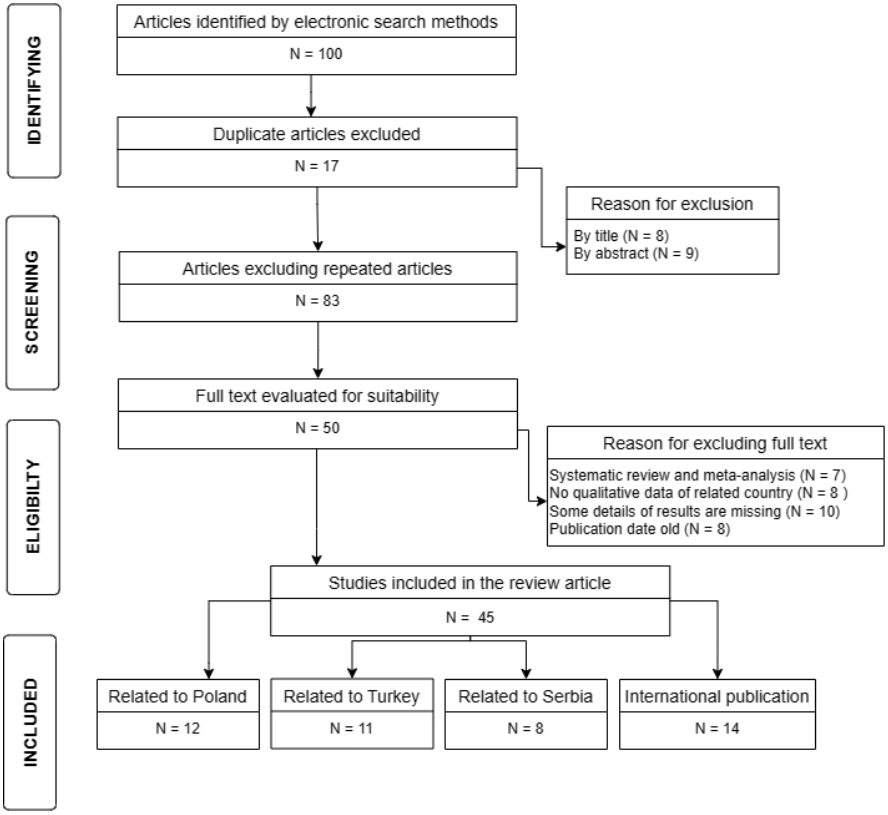

Fig. 1. Flowchart of the selection criteria of studies on TTO.
Source: own elaboration.

3. Research results

3.1. General comparison of TTO in each country

In Poland, Centers of Technology Transfer (CTTs) are defined as a broad range of non-profit consulting, training, and information units that develop programs to promote the transfer and commercialization of technology and all of the tasks that go along with it.

The CTT's key responsibilities include informing about university research, looking for chances to sell the outcomes, and new prospects.

The objectives that are meant to be established by the technology transfer office in Poland include:

- evaluating scientific and innovative capabilities, database creation, and collaboration between research, science, and business;
- Pre-investment studies include identifying the benefits of new products and technologies and comparing them to market alternatives;
- Estimating the size of the prospective market, estimating production and distribution costs, and calculating the necessary capital expenditures;
- Identification of the needs of innovative business entities;
- Technical entrepreneurship's popularization, promotion, and development [*Technology Transfer Centre – general information » Cooperative Bank in Witków*, 2007].

In Turkey, as it is comprehended from the definition of a Technology Transfer Office, the main activity and purpose of the Technology Transfer Center are to share scientific and research advances with the industry and enhance the public relations between these entities to ensure the transformation of technology into economic benefit or to further develop and create new products, applications, machines, and processes.

The Supreme Council for Science and Technology (SCST), which is led by the Prime Minister and is the highest body in the field of science and technology in Turkey, was established to determine, coordinate, and monitor research and development policies within the state and has described one of the three main goals and aims of TTO in the Vision 2023 project of Turkey, which is to focus on technological development. This was mainly due to the dramatic increase in the global competition in long-term research projects [Saritas et al., 2006].

The main objectives of the Technology Transfer Office in Turkey

- To provide education on entrepreneurship, innovation, R&D, and intellectual property rights.
- To create strategies that reduce the risks faced by scientific researchers.
- To assist entrepreneurs in the supply of valid patent documents both at home and abroad.

Patent procurements, intellectual property rights, and licensing academic-based promotions (spin-offs) are by working on market research and enterprise capital provision and project funding, bringing together production sectors and universities to guide them accordingly.

In Serbia, each university has its technology transfer center - said centers all share a common vision, mission, and goal (University of Novi Sad - Danube Center

for Technology Transfer, 2008; Center for Technology Transfer - University of Nis, 2020).

CTT's vision:

Help scientists' and researchers' work led to new and life-improving products. CTT wants its researchers to contribute to the creation of new jobs, and Serbia to become an international market leader.

CTT mission:

Protect intellectual property (IP) produced at the university and facilitate the transfer of IP rights to the industries, resulting in products that improve and increase collaboration between the university and industry and support researchers and students in putting their ideas/projects into practice.

CTT's strategic goals are:

Getting as many people and organizations involved as possible in the knowledge and technology transfer process, strengthening relations between the university and major international partners, as well as gaining recognition as a reliable partner in developing and transferring new technologies and knowledge.

Tab. 1. Elements of comparison in TT between Poland, Turkey, and Serbia

Elements of comparison	**Poland**	**Turkey**	**Serbia**
Main roles of tto	▪ Improving the commercialization of R&D discoveries generated by public research facilities ▪ Enabling greater utilization of existing technology transfer centers ▪ Improving the vocational education and training system by incorporating best practice examples from throughout the world and customizing them to the local context ▪ Promoting entrepreneurship in underserved areas	▪ Connect industry and technology developers and cooperate with the innovations of the public and private sectors ▪ Assist technology developers in applying for patents ▪ Provide the needed support for technology developers ▪ Introduce the IP rights and licensing regulations for technology developers to protect the information produced and the inventions made within the scope of intellectual property and to transfer them	▪ Commercialize the results of scientific research by connecting researchers in faculties and institutes with the private sector ▪ Strengthen technology transfer centers at Serbian universities ▪ Support the scientific and research community in Serbia.

	▪ Finding measures to improve the business environment ▪ Encouraging the creation of local financial instruments in the region [Wolszczak et al., 2017]	to practice [Education, 2018]	
Processes	▪ Direction of the implementation of R&D - commissioned mainly by large enterprises, agencies, and government programs ▪ Direct investments, company cooperation, mergers, joint ventures ▪ Marketing including trade-in patents, licenses, and know-how ▪ Purchase of machinery and technical devices to inspire the structure and method of operation to imitate or create solutions ▪ Provide a didactic process ▪ Manage scientific and popular science publications, conferences, seminars, and fairs ▪ Provide technological consulting and intermediation ▪ Exchange of experiences between scientists and practitioners ▪ Supporting innovative undertakings in small and medium-sized enterprises ▪ Employee exchange ▪ Contacts of individual inventors	▪ Provide services for researchers to the industry needs (including guiding and promoting services) ▪ Monitor and prepare the needed environment for the researchers to develop their projects ▪ Managing the IP rights and licensing services ▪ Exchanging experiments of good practices to support entrepreneurship ▪ Provide the connections between universities and external organizations ▪ Providing the funds as needed	▪ Receive an innovation description ▪ Help with the collaboration with the private sector ▪ Differentiate support for research and business support. ▪ Evaluating technological and commercial readiness for innovation ▪ Raising the level of commercial readiness by financing additional innovation development ▪ Implementing strategies for commercial exploitation of innovation, and finding commercial partners

	▪ Copying third-party solutions ▪ Provide information about technology transfer		
Funding resource	Mainly the private sector including programs such as: ▪ Innovative Economy ▪ Human Capital ▪ Infrastructure and Environment ▪ And for individual voivodeships [Santarek et. al., 2008; Szpilko et al., 2021; Szydło et al., 2022].	▪ External funding through TÜBITAK and SCST funding	▪ The Ministries of Education, Science, and Technological Development, the Innovation Fund, the Delegation of the European Union to Serbia, and the World Bank
Obstacles	▪ Structurally, which results from the specificity of the sectors: economy, R&D, and support, and lack of developed strategies and implemented policies ▪ Systemically, which mainly affects the excess of regulations and legal acts, and largely inhibits the development of academic entrepreneurship ▪ Awareness and cultural barriers ▪ Mentally, which is related to the lack of trust, lack of awareness, and low social acceptance of innovative attitudes ▪ Incompetency in the field of technology transfer (lack of knowledge on such issues as intellectual	▪ Lack of motivation among students to invent new projects ▪ Lack of the needed financial support from funding entities ▪ Lack of assistance by the TTO workers to the students and researchers ▪ Converting the students to other countries to develop their projects due to the lack of the needed support ▪ Lack of competition between students and researchers to develop innovations	▪ The need for chronically lacking funds ▪ Lack of participants ▪ Lack of innovative projects ▪ Lack of infrastructure support for innovation ▪ Attempting to rush research (prototypes) into production is usually more expensive than expected ▪ Neglect to identify the local market's potential for technological adoption ▪ Difficulty to examine and take into account potential sources of conflict related to the transfer of technology

	property, pro-innovation services, financing innovation), and institutional support [Lis, 2018].		
Main agents	▪ Research and development sector institutions such as universities, scientific institutes, and enterprise development departments ▪ Enterprises, especially from the SME sector ▪ Business environment institutions, for intermediating between the science and business sectors [Lis, 2018]	▪ Technology inventors (researchers, students, enterprises, and others), Universities or any TTO, the industry, or the private sector	▪ Transfers can occur between universities, businesses (of any size, ranging from small, medium, to large), and governments, across the geopolitical border both openly and secretly [*Transfer of technology*, 2021]
Transfer medium	▪ Technology purchase, R&D, licensing, and consulting agreements (knowledge transfer), technical staff flow (human capital transfer)	▪ Simple, and exclusive license, transfer, partnership capital placement methods	▪ License agreements for the placement of products on the market (*Innovators get a chance in Serbia*, 2019), cooperative research and development agreements, patent license agreements, educational partnership agreements, and partnerships between the state and local government [*Transfer of technology*, 2021]
Transfer object	▪ Any innovation that is used to reduce the unit production costs or to supply products, increase the quality level, or introduce new or significantly modified - improved products to the market [Blażlak and Owczarek, 2013]	▪ A product, process, service, or any result, with defined success criteria and goals, carried out within a certain period and amount of resources [Tübitak, 2020]	▪ Skills, knowledge, technologies, production methods, samples, and objects [*Transfer of technology*, 2021]

Source: own elaboration.

According to one research, there are primarily three modes of technology transfer (Landry *et al.*, 2010).

Mode 1
- Non-commercial Transfer
- Meetings and/or workshop
- Networking
- Publications
- Staff training

Mode 2
- Commercial Transfer
- Collaboration
- Assisting
- Technical service
- Licensing services
- Commissioned research

Mode 3
- Novel Generation
- Direct and direct spin-offs
- Technology transfer companies

The completion of these three modes will ensure the full service of a TTO providing a connection between university and industry in analyzed countries.

The agreement of academic technology transfer centers which contains 77 Polish entities has gone public about successfully processing 2321 patent applications [Grzegorczyk and Jasiczak, 2020], and 1010 R&D projects in the last 5 years. Poland also was established in 2014 by The Polish Association of University Knowledge Transfer Companies (PSC.) Its purpose is to support the creation of spin-off companies and cooperate with investors, business angels, and innovative entities ready to implement science-based technologies. The association consists of 29 universities which PSC completed R&D a consulting 2130 projects, and the number of companies and administration units for which projects were conducted is 1470. Funds obtained from investors by established spin-off companies were 17 million EUR, and funds received from research grants by established spin-off companies were 34 million EUR [*Polish Association of University Knowledge Transfer Companies - cooperation platform for university SPVs.*, 2014]. After analyzing 3 models of technology transfer, it can be concluded that Poland implemented the first, second, the third

models. The latest of which is realized the most by the knowledge transfer companies of the universities.

According to one published book that has conducted one survey about the services of TTO in Turkey, the Turkish TTO has accomplished mode 1 and mode 2 by providing its service to a wide population and succeeded in acting as a bridge between universities and industries, as well as fulfill the entrepreneurial activities and licensing issues offered by TTOs [Güler and Kirbaşlar, 2020]. It seems like the Turkish TTO's are still trying to finish the third mode.

The scientific research and innovation system in the Republic of Serbia today represents a dynamic sector, closely related to education, economy, and society, with numerous comparative advantages, and potentials, but also various challenges. According to records kept by the Ministry of Education, Science and Technological Development, 123 universities and faculties have been accredited in the Republic of Serbia, 65 of which are of national importance. The scientific and technological system consists of 8 institutes within the Serbian Academy of Sciences and Arts.

3.2. Funding Associates of the Technology Transfer Office

In Poland, the following sources of technology transfer finance are available:

- own funds;
- external funds:
  - public, including a budget, EU, and others.
  - private, including venture capital funds, business angels, and banks (loans, leasing).

In countries with strong economies, 2/3 of the funds are allocated to R&D activities, including technology transfer from private sectors while the remaining is provided from public funds. Unfortunately, the situation in Poland is the opposite (1/3 of expenditure on research and development activities comes from private sources, and 2/3 - from public funds). It should be noted that the chances of obtaining funding and the amount of this funding depend on the level of maturity of the technology involved in the project. Currently, the largest source of funding for technology transfer processes is Funds from Structural elements of the European Union and:

- Operational Program - Innovative Economy.
- Human Capital Operational Program.
- Operational Program - Infrastructure and Environment.
- Regional Operational Programs for individual voivodeships [Laxdal, no date; Lis, 2018].

Despite the enormous funds from the European Union allocated to support the business environment sector, some institutions indicate financial issues (low budget,

lack of financial support, lack of sufficient funds for equipping and adapting facilities) as one of the main obfuscations to their operations [Lis, 2018].

In Turkey, the Supreme Council for Science and Technology chose to support Technology Transfer Offices. TÜBİTAK introduced the 1513 Support Program for Technology Transfer Offices in 2013 as a result. In total, 20 public colleges were financed under the program's idea in 2013 and 2014 (Ttgv, 2020). Moreover, as the main funding and support for TTOs in Turkey, TÜBİTAK provides the needed funding to the universities, training, and research organizations to enhance and develop new ideas and projects, as mentioned in the Research and Innovation Outlook of Turkey. TÜBİTAK provides up to 1 million TL annually (Approximately 55,485 EUR according to the 14.06.2022 exchange rate), and funds up to 60% - 80% of the project's budget [*Polish Association of University Knowledge Transfer Companies - cooperation platform for university SPVs.*, 2014].

In Serbia, as aforementioned, the sector cooperates with the Science Fund of the Republic of Serbia, the Innovation Fund, and others. Project financing is implemented in a manner that ensures competitiveness, quality, practical value, transparency, and the functionality of the results.

The Innovation Fund of the Republic of Serbia is the key state institution supporting innovative activities and managing funds for stimulating innovation. Active since 2011, the Innovation Fund is a pioneer in the institutional implementation of this imperative - primarily by increasing the capacity of start-ups and available resources for their growth. The Fund is thus part of a broader state innovation strategy. From the beginning of the work until today, through the Innovation Fund, 31.2 million EUR have been approved for 227 innovative projects, 3.2 million EUR for 632 innovation vouchers, and 580 thousand EUR for support in technology transfer. In total, slightly more than 37.2 million EUR were approved. More than 3380 applications for innovative projects were submitted to all public calls.

The European Union's support of the Fund, since the beginning of its operational work in 2011, has given a crucial impetus to the financing of innovation in Serbia and the strengthening of links between the research and private sectors. So far, more than 17.5 million EUR have been allocated from the international project auditing funds for the fund's programs. At the same time, one of the priorities of the Government of the Republic of Serbia is to improve the competitiveness of science, research, and innovation in the function of economic development, which is reflected in providing greater funds for financing innovations through the fund, especially starting 2018 (*Innovation Fund*, 2021).

The Science Fund of the Republic of Serbia is a public organization that supports scientific and research activities. It was established in March 2019, to provide funds

and support the conditions for the continuous development of scientific and research activities in the Republic of Serbia necessary for the advancement of a knowledge-based society [*Fond za nauku*, 2019].

3.3. The main scope and process of TTO's activities

Technology Transfer is a broad set of processes that involve a range of interactions such as the flow of knowledge, experience, and equipment between different stakeholders such as the public, firms, financing institutions, research, and educational institutions, non-governmental organizations, and others [Taş, 2014]. The activities of the TTO of the analyzed countries are provided in this part.

In Poland, the primary objective of the CTTs is to promote economic growth and maximize potential innovation in their particular regions by collaborating with businesses, research institutes, colleges, and other organizations in the scope of:

- Encouraging technologies that improve manufacturing efficiency and product quality;
- Identifying the technology needs and possibilities of businesses and institutions;
- Seeking suitable solutions and international partners

From discussions, and legal and financial guidance until the implementation of the project, support is provided throughout the technology transfer process.

CTT's activity at the junction of the spheres of science and business is to utilize the adaptation of modern technologies by small and medium-sized enterprises operating in the region, and thus contribute to increasing innovation and competitiveness of enterprises and regional economic structures (*Technology Transfer Centre – general information » Cooperative Bank in Witków*, 2007).

In Turkey, the technology transfer offices provide a connection to ensure the transfer of technology from universities to the industry and so is the main solution to the serious problems with the commercialization of scientific studies in Turkey.

TTOs must be aware of the following terms to get the desired support and funds from the TÜBİTAK technology transfer offices support program as mentioned in the references [Education, 2018; Tübitak, 2020].

- Awareness, promotion, information, and training services:
    - TTOs must direct and prompt researchers in line with the needs of the private sector organizations within the scope of supported TTO project activities;
    - Informing researchers and the related private sector on technology development, innovation, and intellectual property rights, raising awareness, and providing training on these issues;

  - Provide services that will benefit private sector organizations.
  - Provide project preparation, monitoring, innovation, and entrepreneurship support;
  - Inform private sector organizations and researchers about financing R&D and innovation, facilitating access to funds, and directing these people to the relevant funds.
- University-industry cooperation activities
  - Provide consultancy to the related organizations, mediating national/international partnership agreements, creating a project team in multi-partner projects coordinating activities, as well as presenting the project results.
- Intellectual and Industrial Rights management and licensing services.
- Incorporation and venture services
  - The application of these activities had a main socio-economic impact that is summarized but not limited to;
  - Improved ecosystem and networks for technology transfer among linked entities.
- Increased coordination of various technology transfer capacities and expertise.
- Improved intellectual property and technology transfer policymaking.

In Serbia, the Center of Technology Transfer of the University is an organizational unit that is established to improve the application of scientific research results to develop the economy and society]. Aside from collaboration with the private sector, it is seen as an essential part of the CTT activities.

When it comes to supporting the research the CTT offers:

- Assessing an idea or invention;
- Developing strategies for patent and invention management;
- Taking care of the patents;
- Licensing patents worldwide;
- Supporting start-up or spin-off companies' creation;
- Collaboration between the university and the industry;
- Assistance in identifying funding opportunities;
- Raising awareness, education, and publicity;

Alternatively, when it comes to business support CTT offers:

- Available technologies for licensing;
- Finding the right partner from academia to conduct research for a company;
- Help in finding additional funding.

Cooperation between science and the economy to transfer knowledge and technology and commercialize research significantly affects the socioeconomic growth and development of a country. This cooperation is a key component of the development of Serbia's innovation system.

3.4. Exemplary projects developed by TTO

In Poland, one of the many projects developed by The Polish Association of Centers for Technology Transfer (PACTT) and mentioned in the innovation catalog on their website is a middle ear prosthesis with a handle that attaches itself to the stapes and a fastening element to the tympanic membrane. It is distinguished by the presence of a fastening element to which the first end of the bar is articulated in the central section, and a handle is attached to the other end of the rod, connecting the prosthesis to the stapes. The prosthetic ear is comprised of a shape-memory substance. This project was developed and registered as a patent for the Medical University of Lublin [*Variable length middle ear prosthesis / Innovation Catalogue / PACTT Academic Technology Transfer Centres Agreement*, 2019].

Another important project was developed by the University of Technology in Wrocław, which used a building method and operating principles of a laser-fiber vibrometer, which allows the simultaneous study of vibrations from four distinct points of a vibrating object with excellent measurement precision (at the level of nanometers).

The project includes:

- Optical signal detecting system, notably for laser-fiber vibrometers,
- Device for monitoring vibrations and displacements of objects,
- Software for controlling measurements and recording results [*Laser-fiber vibrometer / Innovation Catalogue / PactT Academic Technology Transfer Centres Agreement*, 2019].

In Turkey, an "autism wristband" produced in Fatih Sultan Mehmet Foundation University's technology transfer office contributes to the personal development of individuals with autism spectrum disorder and permits emotional analysis. The autism wristband is a smart bracelet that can transfer data for 1.5 years using a pen battery that broadcasts the position, pulse, and emotional analysis of individuals with autism to their families without utilizing GPS or GSM, improving their lives for themselves and their families. This technology might be employed in an earthquake, and an earthquake catastrophe coordinating project was also established. TÜBİTAK has also granted this project funding.

Another project developed with the help of the TTO of Istanbul University Assoc. Prof. Dr. Ayca Yıldız Peköz, Lecturer at the Faculty of Pharmacy, won an award

in the pharmaceutical category with her project titled "Development of Triple Combination Oral Gelling in Situ Gel Formulation in the Treatment of Oral Candidiasis".

It is hard to find the projects that are developed by TTO because they do not want to share the ideas of the project. It is usually possible by network or contacts to have similar information.

In Serbia, CTT University of Niš is one of the projects implemented by the Center of Technology Transfer in Serbia and is available only on the website of the University of Belgrade, some of which are listed. This information is not available on the websites of other universities in Serbia.

Another project is the Regional Railway Transport Research and Training Center Foundation. The main activities accomplished under the project expanded the collaboration of universities and research institutes in the region and facilitated the center foundation.

3.5. Quantitative results

As it is mentioned in the study of [Çiftçi, 2017] , some of the metrics that were evaluated to measure the performance of TTOs by the North American Technology Transfer Associations are the patent applications, licensing agreements, and the patents issued. Moreover, the study of [Ustundag et al., 2011] resulted in the importance of evaluating the patents' number of TTOs when measuring their performance.

It is stated that the various metrics provided by the Global Innovation Ranking Index (GII) assist in tracking progress and comparing it to economies in the same region or income bracket. The GII used a chosen group of variables, such as the impact on R&D or the availability of innovation financing, to offer insight into the state of global innovation and thus the performance of the TTOs [*Global Innovation Index (GII)*, 2023].

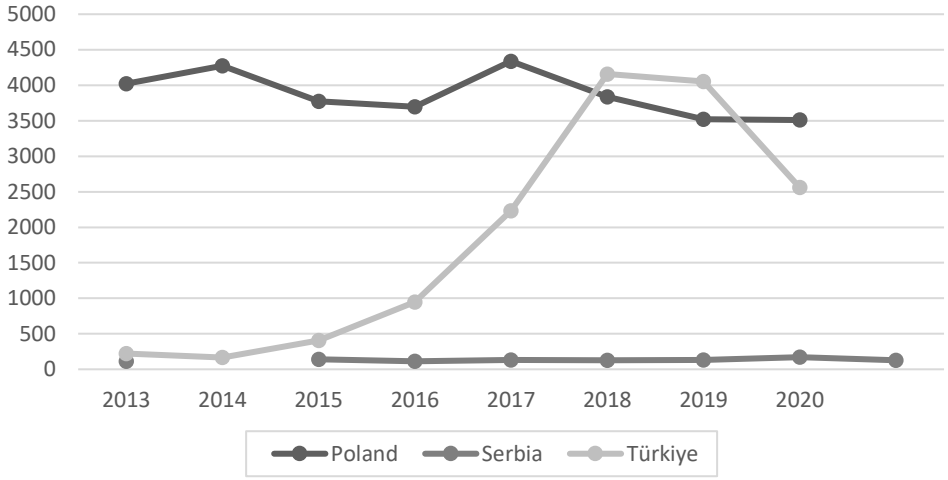

Fig. 1. Patent publications by technology

Source: own elaboration based on [*WIPO IP Statistics Data Center*, 2022].

Fig. 1 shows the changes in the number of patents registered in each country within the past 7 years. As it is indicated in the graph, Poland has shown an increase in patent applications in both periods, from 2013-2014 and 2016-2017. Other than that, it shows a decrease in the application numbers after 2014 due to the lack of interest in applying innovations even though more funding has been provided continuously from the government to support new projects. Moreover, the following decrease registered after 2017 occurred as a result of the decline of the financial support by the funding entities, and is predicted that it will continue to fall in the next following years. Alternatively, Poland registered a peak in all the patent registrations for the three analyzed countries in 2017.

In Turkey, there has been a dramatic increase in applications after 2014, which was the main result of the established funding program by TÜBITAK as mentioned previously in this study. The numbers started to decrease after 2018. In Serbia however, there have been no noticeable changes in the applications for patents in the past 7 years.

It is worth saying that COVID-19 has affected the number of registered applications as all the countries have shown a decrease after 2019.

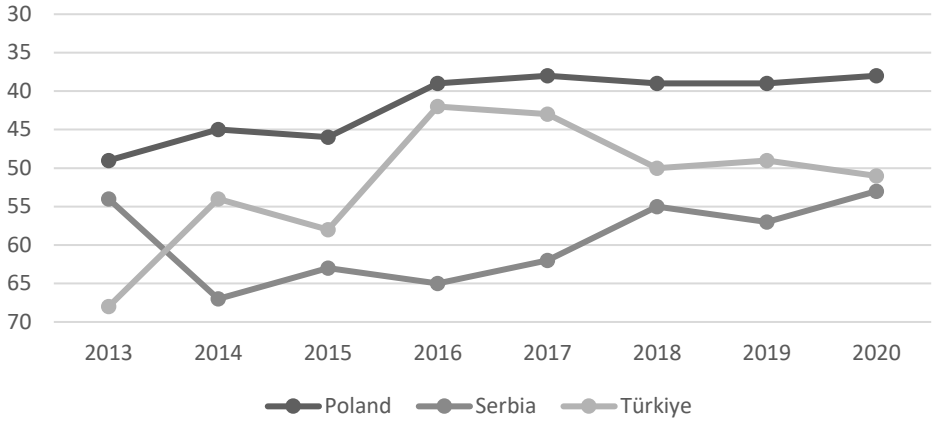

Fig. 2. The global Innovation ranking index.

Source: own elaboration based on [*Global Innovation Index (GII)*, 2023].

Poland went up by 11 in ranking on the Global Innovation Index from 2013 to 2020. Its rank is 38 out of 131 countries for 2020. Whereas Serbia went up by 1 in ranking for the Global Innovation Index from 2013 to 2020. Its rank is 53 out of 131 countries for 2020.

Turkey went up by 17 in ranking on the Global Innovation Index from 2013 to 2020. Its rank is 51 out of 131 countries for 2020. The effect of the funding program provided by TÜBİTAK is obvious since the rank of Turkey went up after 2015.

According to the information written previously in this study, Poland has accomplished the three modes of technology transfer office, which was most likely the reason that made Poland the vanguard comparing it to the three countries. Advancing and developing the groundwork of the technology transfer office that will allow more effective circumstances to develop more technology will provide a notable change in the innovation index ranking of the country.

Analyzing both Fig. 1 and Fig. 2 we realized that Poland did not change its ranking index even though there was support from the European Union after 2017, moreover, the decrease in the number of TTO patent applications did not affect Poland's ranking.

Oppositely, the index of Turkey dropped after 2016 even though the number of patent applications has increased significantly.

Serbia on the other hand has increased its ranking index but no notable change in its patent application number.

4. Discussion

Many existing studies in this field show variations among countries and regions regarding the duration of collaboration between academic institutions and industry, the success of knowledge transfer through patents, venture capital fundraising, and ties with the state. While more international research is required to understand these differences, most studies focus on single countries, and few examine multiple countries and continents.

According to the literature assessment, Poland is the nation with the most developed technology transfer system when compared to the other two countries. Fig. 1 and Fig. 2 show the patent publication numbers by technology and GII, they indicate that Poland has the highest values in both graphs, nevertheless, Turkey scored higher numbers than Poland between 2018 and 2019 in patent publication numbers. The potential reasons for these numbers are all discussed in this part of the article.

The paper of [Łącka and Brzezicki, 2020] has confirmed that between 2015 and 2017, there was a notable upward trajectory in the average efficiency measures within one empirical model of Poland's R&D. During this timeframe, efficiency levels climbed from 58% to 72%. This positive trend was attributable to the enhanced ratios for a significant portion of the universities under study during that period. And concluded that enhancing collaboration between the scientific community and the economy in this field should contribute to boosting the effectiveness of R&D spending while simultaneously raising the country's innovation rates.

Nonetheless, it has been noted in the study of [Pronay et al., 2022] that within Europe, stringent patenting procedures exert a notable adverse impact on TTO performance.

For Turkey, the study of [Kaya, 2015] has explored the transfer of knowledge and technology from Germany to Turkey, drawing insights from various disciplines within the social sciences, including history, political science, international relations, and notably, economics and business studies. Which emphasizes that TT is influenced by a complex interplay of local, national, and international factors, as well as by political, economic, and social processes, and the networks that link scientific communities with business entities.

In the paper of [Çavdar et al., 2017], an analysis of the current situation has been conducted, comparing Turkey's position with that of leading countries worldwide. Turkey ranks lowest in several key areas, including support for private sector R&D, ease of doing business and starting new enterprises, and higher education spending. To address these challenges and enhance its competitiveness, the paper suggested that Turkey can turn to technology transfer policies, transfer offices, and technology

development zones, which offer significant solutions. The paper also provides recommendations for shaping Turkey's technology policies.

One paper published in Serbia [Dukic et al., 2015] confirmed that the Small-Medium sized enterprises (SME) managers often overlook the significance of engaging with stakeholders for innovation. which is directly affecting innovation and TTOs in the country. Additionally, the findings highlight the need for further research to uncover the barriers faced by Serbian SMEs in networking with both domestic and international stakeholders, contributing to their underutilized potential for enhancing innovation capacity and developing TTOs activities.

Conclusions

Although the European Union encourages technology transfer, technology transfer intermediaries such as TTOs lack a standardized set of services. Each country and organization has its unique technology transfer strategy, alternately, in terms of university-industry interactions, Turkey is more organized than its European equivalents. The first 20 institutions financed by TÜBİTAK adopt the same principle in their services, even though each one has its unique activity. TTO is supported by this regularity. Both industry insiders and academics are familiar with TTO and its benefits.

It can be concluded from the definitions, aims, and objectives of the three studied countries that support any entity developing, creating a project, or establishing an idea with the help of the technology transfer office. The technology transfer office is obligated to provide the needed assistance and to promote and protect the ideas of the inventors, as well as enhance the collaboration between industry and developers. While all three countries have the same main goal of increasing the dissemination and marketing of university-based research and projects, they have dissimilar regulatory frameworks controlling academic technology transfer. Based on the information that was analyzed and gathered about the funding of TTO for each country, it can be concluded that the projects of TTO in all three countries are mostly financed from external sources of funding.

In Poland, the National Center for Research and Development (NCRD) is the key entity supporting research and development programs and holding suitable resources. The European Regional Development Fund's Smart Growth Operational Program (SGOP) is the major source of support for entrepreneurs. Its primary function is to assist businesses in increasing their R&D expenditures and improving the circumstances of their R&D operations. It is devoted to large-scale projects with a minimum nationwide degree of developed innovation. The patent applications are

mostly from universities, but there is a noteworthy number of TTOs outside the universities, such as following the scientific parks and the R&D organizations. In addition to that, the financing is majorly taken from the public funding programs and the private sector.

Nevertheless, in Turkey, the Supreme Council of Science and Technology (SCST), is Turkey's highest-ranking policymaking body. Representatives from many ministries, government agencies, universities, and non-governmental organizations (NGOs) in addition to the Private Sector are among the group's members. Recent advances demonstrate that scientific performance is improving, and that the scientific community is spreading globally. However, there is always a need to better the translation of scientific findings into industry innovation. Turkey's economy is still heavily reliant on information and technology imports. In addition to that, the governmental organizations are the biggest support for the funding of TTOs projects and activities, which is the main reason that the funding budget of the TTOs in Turkey is the lowest amongst the analyzed three countries as is seen in the funding section.

On the other hand, in Serbia, the sector for Technological Development, Technology Transfer, and Innovation System, which belongs to the Ministry of Education Science and Technological Development, develops and improves the innovation system, proposes the national innovation policy, contributes to the development of the national innovation system, and implements programs to ensure their technological development. However, in Serbia, TTOs are mostly funded by private sector organizations such as the Innovation Fund, as well as the European Union.

As it is comprehended from the scoop of the three countries, typically the Technology Transfer Offices are established to create a suitable environment for the researchers, students, or technology developers to create, start, or develop their ideas and projects. As well as to support them with the needed counseling and materials if needed. The commercialization and estimation of the value of the projects that are developed under the Technology Transfer Office are one of their main aims as well.

While there is a strong association between R&D spending and innovation, the result of an econometric study shows that gaining licenses does not significantly boost a firm's innovation potential. On the other hand, a collaboration between businesses and research institutions as well as universities increases the innovativeness of the businesses under consideration.

The conducted research and analyses allow indicated the following as the most important conclusions and recommendations. The implementation of three modes of TT [Landry et al., 2010] may affect the level of innovation in the country. It is recommended to implement the three modes of technology transfer in the three analyzed countries, with particular emphasis on the third one. The analyzed countries

require further financing of technology transfer, including the activities of TTO, from external sources. The lack of public and private funds will limit the effectiveness of the TTO and in the long term will affect the level of innovation of the researched countries. Increasing private financing of elements of technology transfer may affect the level of innovativeness of individual countries. It is recommended to create technology transfer programs at the national level, taking into account public-private financing. It is recommended to create programs and legal solutions, for example, tax solutions, to increase the involvement of the private sector in the co-financing of technology transfer processes.

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References

1. Blażlak R., Owczarek K. (Eds.) (2013), *Modele Transferu Technologii*, www.wydawnictwa.p.lodz.pl.
2. Carroll L.S.L. (2017), *A comprehensive definition of technology from an ethological perspective*, Social Sciences, 6(4). doi: 10.3390/socsci6040126
3. Çavdar A. et al. (2017), *Role of the Technology Transfer for Development of Turkey in Science*, Technology and R&D, https://www.researchgate.net/publication/318965595_Role_of_the_Technology_Transfer_for_Development_of_Turkey_in_Science_Technology_and_RD#fullTextFileContent [17.09.2023].
4. *Center for Technology Transfer - University of Nis* (2020), https://www.ni.ac.rs/univerzitet/centri-univerziteta/centar-za-transfer-tehnologija [13.09.2022].
5. Çiftçi F.M. (2017), *Measuring the performance of technology transfer offices (ttos): the case of Turkey*.
6. Damijan J. et al. (2005), *Technology Transfer Through FDI in Top-10 Transition Countries: How Important are Direct Effects, Horizontal and Vertical Spillovers?*, SSRN Electronic Journal, (549). doi: 10.2139/ssrn.404241.
7. Decter M., Bennett D., Leseure M. (2007), *University to business technology transfer-UK and USA comparisons*, Technovation, 27(3), pp. 145-155. doi: 10.1016/j.technovation.2006.02.001.
8. Dukic S., Stankovic L., Lepojevic V. (2015), *Improvement of innovation capacity of SMEs in Republic of Serbia by connecting with key stakeholders*, Engineering Economics, 26(4), pp. 431-441. doi: 10.5755/j01.ee.26.4.8489.
9. Education P. of the C. of H. (2018), *General Directorate of Prime Ministry Legislation*

Development and Publication, https://www.resmigazete.gov.tr/eskiler/2017/12/20171207-5.htm [19.06.2022].
10. Etzkowitz H., Zhou C. (2021), *Licensing life: The evolution of Stanford university's technology transfer practice*, Technological Forecasting and Social Change, 168. doi: 10.1016/J.TECHFORE.2021.120764
11. *Fond za nauku* (2019), http://fondzanauku.gov.rs/about-us/?lang=en [16.05.2022].
12. *Global Innovation Index (GII)* (2023), https://www.wipo.int/global_innovation_index/en/ [11.02.2023].
13. Grzegorczyk A., Jasiczak J. (2020), *Ostatnie 5 lat transferu technologii w Polsce*, https://www.krasp.org.pl/resources/upload/Inne_dokumenty_KRASP/prezentacje/prezentacje_ZP_160604/A_Grzegorczyk_J_Jasiczak.pdf [13.09.2022].
14. Güler M., Kirbaşlar Ş.İ. (2020), *Teknoloji transfer ofislerinin üniversite sanayi işbirliğindeki rolü*, İstanbul: İKSAD.
15. Haudeville B., Dabic M., Gorynia M. (2002), *National differences in technology transfers in East European transition economies*, Mondes en Developpement, 30(120), pp. 75-85. doi: 10.3917/med.120.0075.
16. *Innovation Fund* (2021), http://www.inovacionifond.rs/en/fond/about-fund [16.05.2022].
17. *Innovators get a chance in Serbia* (2019), https://www.srbija.gov.rs/vest/367691 [31.07. 2022].
18. Jarzynowski M. (2020), *Technology Transfer in Poland: Overview*, Technology Transfer and Entrepreneurship, 7(1), pp. 85-91. doi: 10.2174/2213809907666200318124907
19. Kaya H. (2015), *Knowledge and technology transfer from Germany to Turkey: It's past, current situation and future challenges*, Turkish German Affairs from an Interdisciplinary Perspective, (January), pp. 297-322. doi: 10.3726/978-3-653-06267-0
20. Łącka I. (2013), *Technological Cooperation Between Scientific and Research Institutions and Companies As a Condition of the Growth of Innovativeness and Competitiveness of Polish Economy*, Economics and Management, 18(2), pp. 275-285. doi: 10.5755/j01.em.18.2.4467
21. Łącka I., Brzezicki Ł. (2020), *Efficiency of the research and development activities of technical universities in Poland*, Nierówności społeczne a wzrost gospodarczy, 63(3), pp. 258-274. doi: 10.15584/nsawg.2020.3.13
22. Landry R. et al. (2010), *Evidence on how academics manage their portfolio of knowledge transfer activities*, Research Policy, 39(10), pp. 1387-1403. doi: 10.1016/j.respol.2010.08.003
23. *Laser-fiber vibrometer / Innovation Catalogue / PactT Academic Technology Transfer Centres Agreement* (2019), https://pactt.pl/katalog-innowacji/wibrometr-laserowo-swiatlowodowy-60.html [21.05.2022].
24. Laxdal R.E. (no date), *Technology transfer and research projects gsi-fair*.
25. Lis A. (2018), *Główne bariery w systemie transferu technologii w Polsce*, (December).
26. *Official Gazette of RS* (2021), О Иновационој Делатности, No. 110/05.
27. *Polish Association of University Knowledge Transfer Companies - cooperation platform*

for university SPVs (2014), https://psc.edu.pl/en/ [13.09.2022].
28. Pronay S. et al. (2022), *Performance of university technology transfer offices: evidence from Europe and Japan*, International Journal of Productivity and Performance Management, 71(4), pp. 1343-1364. doi: 10.1108/IJPPM-03-2020-0091
29. Salamonowicz M. (2018), *Intellectual property rights licensing and spin-off policy of public universities in United States, United Kingdom, Germany and Poland*, European Journal Of Public Matters, (2), http://www.wipo.int/edocs/pubdocs/en/wipo_ [8.04.2022].
30. Santarek K., Bagiński J., Buczacki A. (2008), *Transfer technologii z uczelni do biznesu. Tworzenie mechanizmów transferu technologii*, Polska Agencja …, http://sba.gov.pl/files/74/81/194/4372.pdf.
31. Saritas O., Taymaz E., Tumer T. (2006), *Vision 2023: Turkey ' s National Technology Foresight Program – a contextualist description and analysis Ozcan Saritas Erol Taymaz Turgut Tumer Vision 2023: Turkey ' s National Technology Foresight Program – a contextualist description and analysis*, (January), pp. 1-30.
32. Schumpeter J.A. (1976), *Capitalism, Socialism and Democracy* (London. George Allen.
33. Sudha Rani S. et al. (2018), *Technology transfer - models and mechanisms*, International Journal of Mechanical Engineering and Technology, 9(6), pp. 971-982.
34. Szpilko D., Szydło J., Glińska E., Kobylińska U., Rollnik-Sadowska E., Ryciuk U. (2021), *Theoretical and practical aspects of business activity. Business planing*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok.
35. Szydło J., Szpilko D., Glińska E., Kobylińska U., Rollnik-Sadowska E., Ryciuk U. (2022), *Theoretical and practical aspects of business activity. Starting a business*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok.
36. Taş R. (2014), *Technology Transfer Offices in Turkish Universities in Comparison With Europe and the U.S.A.*, Proceedings of 6th Annual American Business Research Conference 9-10 June 2014, Sheraton LaGuardia East Hotel, New York, USA, 2013(June), pp. 1-12.
37. *Technology Transfer Centre – general information » Cooperative Bank in Witków* (2007), https://bswitkowo.pl/centrum-transferu-technologicznego-informacje-ogolne/ [21.05.2022].
38. *Transfer of technology* (2021), https://wikisrsr.top/wiki/technology_transfer [31.07. 2022].
39. Ttgv (2020), *Research and Innovation Outlook of Turkey RIOT 2020.*
40. TTO, P. of (2020), *Teknoloji Transferi Terimler Sözlüğü*.
41. TÜBİTAK (2020) *Teknoloji Transfer Ofisleri Destekleme Programi Uygulama EsaslarI*. Istanbul.
42. *University of Novi Sad - Danube Center for Technology Transfer* (2008), https://www.uns.ac.rs/index.php/c-clanice/centri/dctt [13.09.2022].
43. Ustundag A., Uğurlu S., Kilinc M.S. (2011), *Evaluating the performance of technology transfer offices*, Journal of Enterprise Information Management, 24(4), pp. 322-337. doi:

10.1108/17410391111148576/FULL/XML.
44. *Variable length middle ear prosthesis / Innovation Catalogue / PACTT Academic Technology Transfer Centres Agreement* (2019), https://pactt.pl/katalog-innowacji/proteza-ucha-srodkowego-o-zmiennej-dlugosci-535.html [21.05.2022].
45. Wahab S.A., Rose R.C., Osman S.I.W. (2011), *Defining the Concepts of Technology and Technology Transfer: A Literature Analysis*, International Business Research, 5(1). doi: 10.5539/ibr.v5n1p61
46. *WIPO IP Statistics Data Center* (2022), https://www3.wipo.int/ipstats/ipslinechart [13.06.2022].
47. Wolszczak G.A. et al. (2017), *Poland catching-up regions : designing regional technology transfer office - Podkarpackie center for innovation*. 115349. Poland.
48. *Центар за трансфер технологија - Универзитет у Нишу* (2016), https://www.ni.ac.rs/univerzitet/centri-univerziteta/centar-za-transfer-tehnologija [16.05.2022].

Porównanie wybranych aspektów transferu technologii w Polsce, Turcji i Serbii

Streszczenie

Niniejszy artykuł zapewnia wgląd w biura transferu technologii, dokonując porównań między Polską, Turcją i Serbią. Ocenia poziom rozwoju osiągnięty przez każdy kraj w zakresie usprawniania działalności biur transferu technologii. W przeglądzie zastosowano podejście jakościowe. Dane zostały pozyskane z monografii, prac badawczych, artykułów i abstraktów za pomocą wyszukiwania elektronicznego. Jakościowe spostrzeżenia na temat działań i celów TTO uzyskano z odpowiednich artykułów i publikacji rządowych. Wyniki badania ujawniają znaczne rozbieżności między tymi krajami w zakresie motywacji do transferu technologii, spójności ich przepisów, przemysłowego wykorzystania ich innowacji oraz ich ogólnych celów. Wyniki pokazują, że Polska wyłania się jako lider transferu technologii, podczas gdy Turcja boryka się z ograniczeniami budżetowymi, polegając głównie na finansowaniu rządowym. W Serbii wspieranie współpracy między lokalnymi i międzynarodowymi interesariuszami uznano za kluczowe dla wzmocnienia wydajności serbskich TTO. Niniejsze badanie pogłębia wiedzę na temat biur transferu technologii poprzez analizę ich działalności, wyzwań, wpływu społecznego i mechanizmów finansowania w Polsce, Turcji i Serbii. Porównując te konteksty, pogłębia teoretyczne spojrzenie na czynniki wpływające na skuteczność TTO, oferując cenny wkład w tę dziedzinę. Ponadto w badaniu wykorzystano dane dotyczące globalnych wskaźników innowacyjności i liczby patentów w latach 2013-2020. Wyniki tego badania oferują praktyczne spostrzeżenia dla decydentów i interesariuszy w zakresie

transferu technologii, podkreślając różnice w działaniach i wyzwaniach TTO w Polsce, Turcji i Serbii.

Słowa kluczowe

biuro transferu technologii, relacje przemysł-uniwersytet, ośrodek badawczo-rozwojowy, własność intelektualna, Polska, Serbia, Turcja