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CHALLENGES IN THE PROCESS OF TECHNOLOGY TRANSFER FROM HIGHER EDUCATION AND SCIENCE TO BUSINESS, WITH PARTICULAR EMPHASIS ON THE NEED TO VALORIZE KNOWLEDGE

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Abstract. There is no doubt that science is the foundation of all developments. According to politicians, Polish research centers have great potential in terms of competent staff and advanced research infrastructure for creating new technologies that our entrepreneurs can turn into finished products. But is this really the case? What conditions in the technology transfer process do the European Union pay attention to? What should we do to ensure that both commercialization and valorization of knowledge are effective? Technology transfer is a complex process that involves many challenges, such as uncertainty, changes in the environment, associated costs, time constraints, effective communication, institutional and structural barriers, lack of understanding between engineers and lawyers, and, finally, legal, economic and cultural constraints. This article presents the legal, economic and cultural challenges associated with technology transfer, as well as ideas from the European Union to support this process and make it more effective.

Keywords: technology transfer; commercialization; valorization of science; quadruple helix.

INTRODUCTION

There is no doubt that science is the foundation of all developments. According to politicians, Polish research centers have great potential in terms of competent staff and advanced research infrastructure for creating new technologies that our entrepreneurs can turn into finished products. But is this really the case? What conditions in the technology transfer process do the European Union pay attention to? What should we do to ensure that both commercialization and valorization of knowledge are effective?

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1. I STILL MUCH TO BE DONE

The environment for innovation in Poland is still not very favorable, despite the availability of funds and programs. Limited interaction between enterprises, research organizations and higher and vocational education institutions undoubtedly constitutes a barrier to the implementation of innovation. Companies continue to limit their investment and R&D funds, and the environment is not conducive to high-tech industries. Polish SMEs have rather low innovation potential. In addition, the public prosecutor's interest in one of the projects of the National Centre for Research and Development.[1] This obviously does not encourage the idea of applying for innovation funding. We will not build trust among stakeholders when such situations arise. In addition, there is still much to be done in terms of developing a venture capital market that supports spin-offs. Complex intellectual property protocols, low levels of licensing and commercialization of intellectual property, limited opportunities, skills and success rates in business cooperation, unplanned and uncontrolled outflow of knowledge, lack of research services – these are just a few of the problems we encounter daily in the process of technology transfer in Poland. Technology transfer is a complex process that involves many challenges, such as uncertainty, changes in the environment, associated costs, time constraints, effective communication, institutional and structural barriers, lack of understanding between engineers and lawyers, and, finally, legal, economic and cultural constraints. This article presents the legal, economic and cultural challenges associated with technology transfer, as well as ideas from the European Union to support this process and make it more effective.

2. THE FORMULA "SCIENCE IS BUSINESS"

The exploitation of knowledge refers to the commercialization of research knowledge in the form of market solutions. In the case of public research entities, the commercialization of research knowledge usually takes place through the licensing or sale of intellectual property (patents, trademarks and copyrights) or the creation of deep-tech spin-off companies, i.e. academic entrepreneurship. Pursuant to Article 148 of the Act on Higher Education and Science,[2] universities may run academic business incubators

[1] NCBR – a center supporting and developing innovative technological and social solutions, creating an ecosystem of knowledge and information about innovations. Organizes and implements projects contributing to the country's civilizational development, Act of 30 April 2010 on the National Centre for Research and Development (i.e. Journal of Laws of 2024, item 1170 as amended).

[2] Act of 20 July 2018 on Higher Education and Science, Journal of Laws of 2024, item 1571 as amended.

and technology transfer centers. An academic business incubator is established to support the business activities of university employees, doctoral students and students. It may be established as a university-wide unit or a capital company. An incubator in the form of a university-wide unit operates based on regulations approved by the senate. A technology transfer center is established for the purpose of direct commercialization, consisting in the sale of scientific results or know-how related to these results, or making these results or know-how available for use, in particular based on a license agreement, rental or lease. Commercialization can be viewed from various perspectives: as a chain process from the creation of an idea to the sale of a product to customers, as a transfer of knowledge or technology from scientific centers or research units to industry, or finally as the last stage in the development cycle of a new product, thus not considering ideas as an important factor in this process.[3]

To support the commercialization of knowledge, many universities and research and technology organizations (RTOs) have established comprehensive internal support services, such as technology transfer centers (CTTs). Research and technology organizations (such as the Polish Łukasiewicz Research Network) have a public mandate to support society and the economy by promoting the use and commercialization of research and technology. Transfer channels are crucial for RTOs in fulfilling this mandate and creating impact and value for knowledge users and in collaboration with them. It is said that Łukasiewicz is part of science that works for entrepreneurship and supports the development of Polish companies. Operating under the formula "Science is business", Łukasiewicz meets with entrepreneurs and offers solutions that help streamline business operations and create technologies that change reality. In accordance with the Act of 21 February 2019 on the Łukasiewicz Research Network.[4]

The objectives of the Network are: conducting applied research and development work, and in justified cases also basic research, including for national defense and security, which is particularly important for the implementation of the state's economic and innovation policy as defined in development strategies and the state's scientific policy, transferring knowledge and implementing the results of scientific research and development work into the economy, supporting the state's economic policy, in particular by: forecasting trends and the effects of technological changes that may have a strong impact on society and its development, analyzing the current state of the art and developing technological roadmaps for public policy purposes,

[3] Depending on the approach: Godin 2006; Rothwell 1994; Schilling 2017; OECD Commercializing Public Research: New Trends and Strategies 2013; Etzkowitz and Leydesdorff 2000; Kotler and Keller 2016; Cooper 2019.

[4] Journal of Laws of 2024, item 925.

stimulating investment by entrepreneurs in scientific activities, and conducting activities aimed at shaping public awareness of advanced technologies.

Łukasiewicz embodies Poland's aspirations to be a partner for the best European and global experts, both in the world of science and entrepreneurship. Research institutions such as Łukasiewicz certainly strengthen the links between science and business. They have a diverse knowledge base that can be used in technology transfer processes. Their employees are highly competent and have close contacts with industry. However, these contacts are very often based on individuals rather than on the institution/company itself. In a broader sense, there is a lack of entrepreneurial culture and a reluctance on the part of scientists to cooperate with business and commercialization. Employees have been using familiar patterns of operation for years, and suggestions for change are seen as pirate boarding.

Through CTT, universities offer their researchers support in preparing or reviewing agreements concerning technology transfer and joint intellectual property rights, preparing and reviewing cooperation agreements, service agreements and research agreements, preparing or reviewing agreements concerning the implementation of publicly funded projects, assistance in preparing and submitting applications for funding in competitions organized by public institutions, assistance in preparing company statutes and resolutions of management bodies, and advice on the legal aspects of company operations. However, in my opinion, there is a definite lack of a corporate approach here. Internal procedures in research centers are very lengthy. Too long for the patience of an entrepreneur. There are also too many projects whose sole purpose was to obtain funding, without regard for the broader aspects of innovation development, technology transfer and, ultimately, implementation.

3. TECHNOLOGY TRANSFER FROM HIGHER EDUCATION AND SCIENCE TO BUSINESS

Ideas on how to accelerate technology transfer from higher education and science to business are no secret, and sometimes even obvious. The problem is rather how to activate them in a holistic and systematic way. We certainly need to have the same level of awareness about what intellectual property rights are and what their value is. Training in intellectual property rights increases researchers' ability to create and manage intellectual property rights, enabling them to gain recognition and protection for the innovative knowledge and solutions they create – better intellectual property rights management practices among employees mean both evidence of research excellence and new ways of generating income. In addition, employees need to know what the common intellectual property rights strategy, remuneration

model and required management practices are. The organization's objective must be clear – revenue, number of intellectual property rights transferred? It is necessary to prepare model agreements and practical guides, as well as to provide practical support. A standardized intellectual property rights protocol ensures uniform and effective management of intellectual property rights across the entire entity, enables smooth and transparent business cooperation, and increases the potential resulting from the use of research results. Deeper and more holistic cooperation should be implemented. We should learn from each other and share knowledge about technology transfer. For example, more than 90 Polish universities and research organizations participate in the Polish Association of Technology Transfer Centers (PACTT), which offers good opportunities to exchange experiences in the management of intellectual property rights and related issues.[5]

Comparing yourself with other organizations and learning from them can also be a useful tool.

More professional, more international cooperation, models based on greater risk, for example with the participation of international venture capital investors, can bring more ideas and possible solutions. Exposure to criticism from research teams can make development more effective.

On the other hand, creating any kind of support for scientific research is invaluable. At the Warsaw University of Technology, all you need is a business idea and the Innovation Center there will launch a special program.[6] At the Finnish organization VTT, an incubation team consisting of seven full-time specialists is responsible for developing entrepreneurial skills. Another example is the AHEAD program implemented by the Fraunhofer Institute in Germany.

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[5] See https://pactt.pl/ [accessed: 29.12.2025].

[6] During the initial consultations, candidates qualify for the pre-incubation program to analyze competition and market potential, fill gaps in team competencies, and initiate the intellectual property protection process. This stage lasts about 8 weeks. Each year, approximately 40 teams receive support within 4 editions of the program (10 teams per edition). Around 3-5 teams that are ready to dedicate more time and energy to developing their projects move on to the second stage. This is the time when they work on their business model, build a sales strategy, and develop an MVP. At the end, a Demo Day is organized with the participation of investment funds. This stage lasts about 16 weeks. For teams ready to establish a company, cooperation with IBS (Institute of Applied Research) begins. Companies created as a result of the pre-incubation program are not left on their own. Initially, they receive office space from PW on preferential terms in a modern office building. Throughout the incubation period, the company receives various forms of support, from mentoring and consulting in all areas of business activity to access to research services and laboratories, as well as company valuation. The offer also includes numerous networking events. As part of the acceleration package, WUT provides services worth PLN 150,000 and funding in the same amount, totaling PLN 300,000. Each year, 2-3 companies are selected for which we strive to secure a higher level of financing. The best entities participating in PW programs can receive total funding of up to PLN 1 million.

In addition, mentoring is essential to combine specific scientific and technological knowledge with skills in marketing, science-based start-ups, intellectual property rights management, etc., already at the concept verification stage. For example, the LET-in pre-incubation services at INESC TEC in Portugal are run by three full-time experts in collaboration with a network of technology and business mentors who are involved in projects on an ad hoc basis.

Proper promotion and communication of research services for businesses should be an ongoing task for the marketing departments of research centers. For example, the Warsaw University of Technology organizes matchmaking events and has a special "sales" department responsible for "selling" intellectual property. The Finnish VTT has a special customer service unit employing dozens of salespeople and customer managers.

The EU takes the view that, in particular, countries should facilitate the creation of links between innovation ecosystems, research and technology infrastructures, pre-incubators, incubators, start-up workspaces, centers, knowledge and technology transfer offices, IT and digital environments, legal advisors, and other relevant entities, including policy makers, across Europe to promote a more efficient process of knowledge valorization and dissemination among various beneficiaries.

There is no doubt that the active involvement of public research organizations in intellectual property management and knowledge transfer is fundamental to achieving socio-economic benefits.[7] After all, the effective use of publicly funded research results depends on proper intellectual property management.[8] Furthermore, the development of entrepreneurial culture and related skills in public research organizations is crucial. Knowledge transfer has been defined as a strategic mission in the European Union.[9] Therefore, research organizations should support the development of knowledge transfer capabilities and skills in public research organizations.[10]

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[7] Commission Recommendation of 10 April 2008 on the management of intellectual property in knowledge transfer activities and Code of Practice for universities and other public research organizations (notified under document number C(2008) 1329) (Text with EEA relevance), http://data.europa.eu/eli/reco/2008/416/oj [accessed: 29.12.2025].

[8] The Commission Communication of March 10, 2020, entitled "A New Industrial Strategy for Europe" and its 2021 update, the importance of intellectual property management was highlighted, in particular raising awareness of intellectual property among the research community, and a strategy on standardization was announced to support a more assertive stance on EU interests.

[9] Ibid.

[10] The European Union should develop and implement strategies for disseminating and exploiting the results of research and innovation projects to further increase the availability and use of these results and accelerate their potential exploitation. See, for example: Council conclusions on a European strategy for strengthening higher education institutions for the future of Europe (2022/C 167/03).

4. CHALLENGES IN TRANSLATING RESEARCH AND INNOVATION INTO SOCIETAL APPLICATIONS AND ECONOMIC VALUE

The research and innovation ecosystem has undergone profound changes since Commission Recommendation 2008/416/EC,[11] which was mainly aimed at public research organizations. Therefore, in the Council Recommendation (EU) of 2 December 2022 on guiding principles for the valorization of knowledge[12] indicated that an update is needed to focus on maximizing the value of all knowledge assets generated by various entities in a dynamic research and innovation ecosystem. In the EU's view, new challenges and developments need to be addressed, such as increasingly complex knowledge value chains, new market opportunities created by new technologies, new forms of cooperation between industry and academia and between the public sector and academia, citizen engagement, as well as foreign interference in research and innovation and reciprocity in the management of intellectual assets in the context of international research and innovation cooperation. The need to focus on the entire research and innovation ecosystem and its links, on co-creation between actors and on the creation of social value was emphasized. Issues of intellectual asset management and the development of an entrepreneurial culture and practices and skills in this area were also included in the guiding principles. In addition, attention was drawn to new needs to increase the impact of research and innovation, such as addressing new and recurring policy challenges, improving citizen engagement and exchanging best practices between different research stakeholders.

The European Union places great emphasis on the valorization of knowledge as the transformation of research results in sustainable products and solutions for the public good. It is therefore not only about economic benefits, but above all about benefits for society, such as social progress, environmental protection and improved health policy. Knowledge valorization is the process of creating social and economic value from knowledge by connecting different areas and sectors and transforming data, know-how and research results into sustainable products, services, solutions and knowledge-based policies that benefit society.

Knowledge valorization is a paradigm shift, bringing new aspects that will maximize the value of current and future research, innovation and knowledge assets, including tacit knowledge. Tacit knowledge is any type of knowledge that cannot be codified and communicated as information through

[11] Commission Recommendation 2008/416/EC of 10 April 2008 on the management of intellectual property in knowledge transfer activities and Code of Practice for universities and other public research organizations (OJ L 146, 5.6.2008, pp. 19-24).

[12] Council Recommendation (EU) 2022/2415 of 2 December 2022 on guiding principles for the valorization of knowledge, http://data.europa.eu/eli/reco/2022/2415/oj [accessed: 29.12.2025].

documentation, scientific papers, lectures, conferences or other communication channels.

Such knowledge is more effectively transferred among people who share a common social context and physical proximity. Knowledge valorization will be beneficial for policymaking and will lead to the development of new ways of monitoring and evaluating scientific research and innovation through the development of indicators and measurement tools.

The valorization of knowledge in research and innovation policy is essential. However, this process should be considered in a broader context. It is equally important to promote gender equality and diversity (see the requirement to introduce a Gender Equality Plan in the organization) and to promote the development of competences and attract/retain talented employees. Intellectual asset management, including mutual learning and sharing of good practices, is also considered important.

In many European countries, as indicated by research [Zakrzewska-Bielawska, Flaszewska, and Sowa 2024], first and foremost, valorization activities are undertaken, for which the mobilization of knowledge is an important part of the process. Irish universities have emphasized that there has been a change in this area and that for research funding institutions, it is not only the research idea, citations or the quality of researchers' publications that are key, but also the impact of research results on society. Therefore, when preparing a research project, it is necessary to indicate not only the potential economic benefits, but also the social and environmental benefits, which in turn demonstrates the need to take sustainable development into account in the research work undertaken. A clear distinction is made between valorization and commercialization, and the key objective is to maximize the impact of research and education, with this impact being perceived as financial, social, environmental or shaping the reputation of the university. As one respondent said, a university is not a venture capital fund. Its task is not to maximize the amount of money, but to ensure that knowledge reaches the world, which is why social good is important to us.

Knowledge valorization at universities in the Netherlands is as important as research and education. Recently, it has been gaining prominence and is reflected in new academic roles, such as "Vice Dean for Valorization" or "Impact Developer."

Interestingly, commercialization, which primarily generates economic value, continues to be crucial at American universities.

In Poland, the Law on Higher Education and Science states that 'universities and other research institutions carry out a mission of particular importance to the state and the nation: they make a key contribution to the innovation of the economy, contribute to the development of culture, and help

shape the moral standards applicable in public life.[13] In Poland, valorization seems to dominate over commercialization. Commercialization is growing, but it still accounts for a smaller part of university activity and is more difficult, more costly and riskier. Polish analyses and university experiences show that the biggest obstacles to commercialization are insufficient funding for the early stages of research (the so-called 'valley of death'), complicated administrative and legal procedures, a lack of business experience among scientists, and a low willingness among companies to invest in high-risk technologies.

EU institutions[14] draw attention to the need to strengthen knowledge valorization capacities using financing tools, strategies and appropriate frameworks, and by strengthening networks of intermediaries and coordinators in the innovation landscape. They also refer to the need to create a culture of knowledge valorization by fostering cooperation between researchers and industry and by improving training programs for entrepreneurship and innovation in all disciplines.[15] As politicians point out, the valorization of knowledge is an

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[13] Excerpt from the preamble to the Act of 20 July 2018 on Higher Education and Science (Journal of Laws of 2024, item 1571 as amended).

[14] The valorization of knowledge is a recurring topic of discussion at Council meetings devoted to scientific research. In December 2022, the Council adopted a Council Recommendation on guiding principles for knowledge exploitation, and in December 2023, ministers held an orientation debate on 'Exploiting research as a tool for economic and industrial recovery and resilience'.

[15] Conclusions of the Council of the European Union: "Enhancing the value of knowledge as a tool for resilient and competitive industry and strategic autonomy in an open economy in Europe", approved by the Council at its 4026th meeting held on 23 May 2024. https://data.consilium.europa.eu/doc/document/ST-10182-2024-INIT/pl/pdf. This document also took into account the EU Council conclusions of 26 November 2021 on the future governance of the European Research Area1 , which set out the policy agenda in this area for 2022-2024, including a specific action entitled 'Improving EU guidance on better knowledge valorization', aimed at, among other things, developing and approving guidance on knowledge valorization; the EU Council conclusions of 17 November 2022 on the new European Innovation Plan (NEIA)2 , which highlights the importance of accelerating access to scale-up financing for start-ups and SMEs, supporting, attracting and retaining talent, including in the high-tech sector, improve and consolidate innovation ecosystems and address the innovation gap in Europe; EU Council conclusions of 2 December 2022 on research infrastructures, which recognize the open access policy for research infrastructures as an important contribution to stimulating the flow of knowledge and the circulation of talent, strengthen European cooperation in research and innovation at international level and enhance the competitiveness of the European research and innovation ecosystem at global level; Council Recommendation (EU) 2022/2415 of 2 December 2022 on guiding principles for the valorization of knowledge, supported by the Code of Conduct on the Management of Intellectual Property and the Code of Conduct on Standardization adopted in March 2023, and the Code of Practice on Industry-Academia Co-creation and the Code of Practice on Citizen Engagement for Knowledge Valorization adopted in March 2024 – which defines the concept of knowledge valorization, including the creation of social and economic value, the conclusions of the Council of the EU of 23 May 2023 on high-quality, transparent, open, reliable and fair scientific publishing; the EU Council conclusions

effective tool for increasing the competitiveness of our industry and improving the lives of citizens. They emphasize that we cannot afford to allow our wealth of knowledge to remain in laboratories and not be transformed into concrete projects for our society. Only by making full use of scientific research and innovation will we be able to compete internationally and take a leading role in the future knowledge-based industrial revolution.[16] It is therefore necessary to accelerate access to finance for start-ups and SMEs to scale up their activities, support, attract and retain talent, including in the high-tech sector, improve and consolidate innovation ecosystems, and address the innovation gap in Europe.[17] The need to pursue a policy of open access to research infrastructures, stimulate the flow of knowledge and the circulation of talent, strengthen European cooperation in the field of research and innovation at international level, and increase the competitiveness of the European research and innovation ecosystem at global level is also emphasized.[18] It is important to develop a culture of entrepreneurship and practices in this area. Member States should enable immediate open access to scientific publications on the basis of open licenses. Research data should be findable, accessible, interoperable and reusable (FAIR principle) and implement the principle of 'open as far as possible, closed only when necessary'.

More effective valorization of knowledge is key to boosting the EU's global industrial competitiveness and can contribute to the green and digital transitions of society. It can also contribute to increasing the Union's resilience and building its strategic autonomy in the face of threats arising from recent and ongoing crises and the complex geopolitical situation. One of the undeniable challenges is to reduce the Union's dependence on energy,

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of 8 December 2023 on strengthening the role and impact of research and innovation in policy-making in the Union , in which it recalls that regional development is primarily the responsibility of national and regional governments, which can use EU cohesion policy funds and the smart specialization strategy to increase interaction and cooperation between different stakeholders in innovation ecosystems and to reduce disparities; and in which it encourages the Commission, in cooperation with the Member States, to promote the role of evidence-based scientific knowledge and its cross-cutting integration into public policies by continuing its work on mapping existing practices in the field of knowledge valorisation in policy-making, and calls on the Commission to promote instruments and actions that value the concept of 'science for policy', including its knowledge valorization dimension; EU Council Recommendation of 18 December 2023 on a European framework for attracting and retaining talent in research, innovation and entrepreneurship in Europe.

16 Ibid.

17 Conclusions of 17 November 2022 on the New European Innovation Agenda (NEIA), https://data.consilium.europa.eu/doc/document/ST-10182-2024-INIT/pl/pdf and https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:52022IR4105 [accessed: 29.12.2025].

18 Conclusions of 2 December 2022 on research infrastructures, https://www.consilium.europa.eu/pl/press/press-releases/2022/12/02/research-infrastructures-council-adopts-conclusions/ [accessed: 29.12.2025].

electronic components and critical raw materials, which could affect its industrial competitiveness, its position as a global technology leader, its security and the well-being of its citizens.

The EU faces challenges in translating research and innovation into societal applications and economic value, and in retaining the latter within the EU. Addressing these challenges is a prerequisite for the valorization of knowledge and is essential for the functioning of the internal market and for the well-being and prosperity of society. Effective valorization of knowledge from research and innovation would be a key catalyst for this process, as it would ensure that the Union generates and capitalizes on its innovative potential. Knowledge valorization is a powerful tool for supporting the Union's resilience. By strategically exploiting and translating knowledge into practical and innovative solutions, the Union and its Member States can strengthen their global competitiveness and resilience. To this end, the Union and its Member States should focus on strengthening European knowledge valorization capacities and creating a strong European culture of knowledge valorization, while also developing strategies to increase the security of scientific research.

The EU calls on Member States to establish links between the actors involved in these initiatives to improve the uptake of innovation in industry, the public sector and society. The strategic importance of critical and emerging technologies – such as artificial intelligence, life sciences technologies and advanced materials – in strengthening the Union's position in global value chains and in enhancing its resilience and sustainable development, including strategic reindustrialization objectives, is highlighted. It is emphasized that the dissemination of these technologies is key to maintaining the Union's technological leadership and facilitating smarter and more cost-effective production in the Union. In addition, they also play a role in addressing important societal challenges related to democracy, inclusiveness, public health and well-being, security and climate change.

The Council also draws attention to the importance of adequate investment in basic research, including collaborative research, and in social sciences, arts and humanities, to respond to societal needs and sustain the basis for the Union's competitiveness. It is not only research at high TRLs that should be funded. It is also often research covering several fields that ensures the effective transfer of knowledge to the market. That is why it is so important to monitor the usefulness of the research carried out and its absorption by the market and society. Regional, national and European funding programs should be coordinated and complementary, in line with the strategies adopted at the relevant levels. The European Commission should play a key role in responding to the varying levels of achievement of Member States and regions in research and innovation by strengthening and connecting innovative ecosystems. Access to risk financing and the raising of private and public seed and growth capital

should be facilitated, especially for spin-offs, start-ups, scale-ups and SMEs, through cooperation with the banking sector, private investors and venture capital funds, including through the European Innovation Council. Another challenge appears to be public procurement regulations. On the one hand, public procurement is seen as a booster for innovation, given that public procurement expenditure in the EU accounts for around 14% of GDP.[19] This means that the public sector is one of the largest customers in the economy. If such a customer starts buying innovations, the market must adapt. It therefore seems necessary to thoroughly examine ways of supporting and mitigating the risks associated with the use of this instrument to raise awareness and deepen knowledge about public procurement of innovation in Member States. The question is whether, for the sake of promotion, it would be possible to consider leaving intellectual property rights with public procurement contractors.

And finally, to strengthen citizens' trust in science and innovation, it is necessary to effectively inform the public about the benefits of knowledge valorization in everyday life. It is equally important to actively involve citizens in research processes and to develop a demand-driven approach to innovation. It is also necessary to expand the educational opportunities for students and researchers in the specific needs of industry and society, which will stimulate them to create innovative solutions and strengthen their communication skills in cross-sectoral contacts. All fields of science and education should work closely with industry to respond effectively to societal challenges. It is also important to counteract gender and diversity biases, eliminate inequalities and support talent development by promoting positive role models and disseminating good practices.

It is also crucial to develop the skills of employees through training, upskilling and lifelong learning, especially in the field of innovation and digital technologies. In this context, it is advisable to maintain programs on intellectual property management for researchers and entrepreneurs and strengthen cooperation with knowledge and technology transfer offices.

CONCLUSIONS

Effective knowledge valorization requires treating it as a continuous process. The European Union emphasizes that Member States should support initiatives that promote networking between entities involved in the creation and use of knowledge.

In the Polish context, the Łukasiewicz Research Network is particularly well suited to play this role. Without close cooperation between universities,

[19] Order for innovation (News from *Polski Fundusz Rozwoju S.A.*) | PFR S.A. Company Website.

research institutes and the business sector, knowledge valorization will not be possible.

Building a culture of valorization means creating an environment in which individuals, institutions and enterprises understand the value of translating research results into practical outcomes and actively participate in this process. A reliable evaluation of research is of key importance here. The management of scientific organizations should be aware of the challenges associated with valorization, support and reward activities in this area, streamline internal procedures and promote diversity and inclusiveness.

It is also important to understand the role of the so-called 'quadruple helix', comprising academia, the public sector, industry and civil society. Co-creating a shared industrial-academic ecosystem in which all these actors work proactively for the common good is fundamental to the effective creation and valorization of knowledge.

Facilitating the valorization of research results in Europe is essential to make better use of private investment and strengthen the resilience and competitiveness of EU industry. Public-private cooperation is of strategic importance in this process, but the public sector must act faster, monitor the market more closely and respond more efficiently. Aligning research results with the needs of the market and society is the basis for the creation of useful technologies, products and services. Strengthening technological position, economic resilience and competitiveness require a stable legal environment, a reduction in regulatory burdens and the elimination of legal barriers.

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