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THE LEVEL OF INNOVATION IN ENTERPRISES IN THE KUYAVIAN-POMERANIAN REGION

Iwona POSADZIŃSKA

Bydgoszcz University of Science and Technology; iwona.posadzinska@pbs.edu.pl,
ORCID: 0000-0001-8805-8255

Purpose: The aim of the article is to determine the level of innovation in enterprises in the Kuyavian-Pomeranian region.
Design/methodology/approach: The research comprised an analysis of specialist literature on innovation and the transfer of knowledge and technology from research institutions to the economy, along with a representative questionnaire survey of enterprises in the Kuyavian-Pomeranian region.
Findings: The article emphasizes the types, significance, and level of innovations developed and implemented by the researched entities. It identifies the types of innovations, their sources of financing, whether they were developed independently or in collaboration, and the degree of novelty of the changes introduced in 2023-2024.
Research limitations/implications: Future research should undoubtedly continue to examine enterprises and employees, monitoring changes in cooperation between scientific institutions and business and identifying both positive practices and barriers in the innovation creation process.
Practical implications: Effective innovation management may generate measurable benefits for enterprises and other organizations, not only in terms of improved competitiveness and market position, but also through the strengthening of cooperation with scientific and research institutions. This is relevant not only for rapidly developing industries characterized by dynamic change, but also for other sectors. It concerns both large entities, considered centers of innovation creation, as well as micro, small, and medium-sized enterprises, which dominate the economy in terms of number and potential.
Social implications: Theoretical and practical aspects of innovation and cooperation between enterprises and scientific and research institutions (including universities).
Originality/value: The research findings have both theoretical and practical value, particularly with regard to data collected during the implementation of the project – Doskonalenie procesu transferu i komercjalizacji rozwiązań innowacyjnych między nauką a gospodarką, "Nauka dla Społeczeństwa II" (Improving the Process of Transfer and Commercialization of Innovative Solutions between Science and the Economy, 'Science for Society II'), part of which is presented in this article.
Keywords: innovation, enterprise, university, knowledge and technology transfer.
Category of the paper: General review.

1. Introduction

Academic and scientific research institutions are becoming increasingly important in the transfer of knowledge and technology to enterprises. This is related to the pressure from the business environment to implement innovations in all areas of their operations.

This article was prepared as part of a project carried out by Bydgoszcz University of Science and Technology entitled 'Doskonalenie procesu transferu i komercjalizacji rozwiązań innowacyjnych między nauką a gospodarką, "Nauka dla Społeczeństwa II"' (Improving the Process of Transfer and Commercialization of Innovative Solutions Between Science and the Economy, under the program 'Science for Society II'). The publication was co-financed from the state budget within the program of the Minister of Education and Science entitled Science for Society II, project no. NdS-II/SP/0235/2024/01. The amount of funding was PLN 1,000.00, and the total value of the project was PLN 626,941.33.

The project aimed to identify and redesign the processes of cooperation between Bydgoszcz University of Science and Technology and its socio-economic environment. To achieve this aim, several specific goals were defined: identifying the factors influencing the growth of activity and competitiveness of the science sector in innovation development and external collaboration; increasing the number of enterprises operating on innovative solutions generated through university-industry cooperation; stimulating the development of pro-innovative solutions in enterprises through collaboration with Bydgoszcz University of Science and Technology; and conducting benchmarking to identify good practices in innovation transfer and commercialization. Implementation of these objectives required tasks involving an in-depth analysis of secondary sources, including the literature, statistical databases, and published results of scientific research on innovation, technology transfer, commercialization, and university–business cooperation, as well as the conduct of original empirical research based on primary sources of information created for the purposes of the project, using both quantitative and qualitative methods.

The results of the quantitative study of enterprises from the Kuyavian-Pomeranian region relating to innovation processes and cooperation with scientific institutions, including Bydgoszcz University of Science and Technology, will be disseminated in monographs and academic journal articles. This article presents the project assumptions and selected findings from the empirical research.

2. Concept and typology of innovations

Progress, improved quality of life, and new opportunities for meeting societal needs are the outcomes of scientific advancement and the support of innovation processes. In this context, the project Improving the Processes of Transfer and Commercialization of Innovative Solutions Between Science and the Economy ('Science for Society II'), carried out at Bydgoszcz University of Science and Technology between 2024 and 2026, addresses the key challenge of enhancing the development potential of social and business organizations and, consequently, of consumers, who benefit from higher-quality products and services. Changes resulting from the Fourth Industrial Revolution (Industry 4.0) have prompted many operating enterprises to seek new paths of development. The integration of new technologies and knowledge-based solutions into the production process requires an innovative approach to problem-solving and the creation of conditions that foster creativity. In order to remain competitive in a rapidly changing environment, companies must continuously develop new products, services, and business models. Contemporary development trends indicate that enterprises built on two pillars: knowledge and innovation, achieve competitive advantages. This in turn provides sustainable enterprise development (Podgórska, 2022). Innovation can be understood as the ability to search for and create new solutions, adapt them to specific conditions, implement them in practice, and subsequently disseminate them (Perry-Smith, Mannucci, 2017). Innovation processes vary across different types of institutions, including scientific, economic, political, or cultural organizations. Innovations result from interactive processes of generation, diffusion, and application of knowledge. Innovations in science and technology are of particular importance, as they not only improve products and services but also contribute to the development and preservation of human life. For these reasons, innovations related to sustainable development are becoming increasingly significant.

The literature provides a range of approaches to defining innovativeness. Numerous studies emphasize the distinction between the concepts of innovation and innovativeness. Table 1 presents selected definitions.

Table 1.
Definitions of innovation and innovativeness

Concept	Author/authors	Definition
Innovations	Donatella Cavagnoli	It is the process of creatively applying knowledge and converting both the internal and externally acquired knowledge into new products, services, or processes.
	Joe Tidd, John R. Bessant	It is a process in which an identified opportunity is transformed into a new idea, which subsequently finds broad practical application.
	Agnieszka Sopińska, Piotr Wachowiak	Innovations are the outcome or process of introducing new or substantially improved solutions to the market.

Cont. table 1.

Innovativeness	Robert Majkut	At its core, innovativeness involves the selective search and application of innovations within the competitive rivalry among enterprises to expand their market share.
	Jill E. Perry-Smith, Pier Vittorio Mannucci	The ability to search for and generate new solutions, adapt them to specific conditions, implement them in practice, and ultimately disseminate them.
	Małgorzata Golińska-Pieszyńska	The ability to continuously search for, implement, and promote innovations.

Source: own study, based on: Cavagnoli, 2011; Golińska-Pieszyńska, 2015; Majkut, 2021; Perry-Smith, Mannucci, 2017; Sopińska, Wachowiak, 2016; Tidd, Bessant, 2018.

The multiple interpretations of the concepts of innovation and innovativeness indicate the complex nature of this subject. Innovations are understood as various types of novelties, both in products and services. In contemporary enterprises, the ability to introduce innovations plays a significant role, constituting an important factor of competitiveness and enables them to outperform market rivals. Innovativeness encompasses the creation of an organizational culture that encourages creativity, risk-taking, and experimentation. It requires organizations to maintain appropriate structures, processes, and resources that support the development of innovation and creativity. While several types of innovations can be distinguished, eco-innovations are gaining increasing importance due to their positive impact on the natural environment. Table 2 presents the types of innovations along with their characteristics.

Table 2.
Types and characteristics of innovations

Type of innovation	**Characteristic**
Product	They relate to the improvement of an existing product or the introduction of a new one to the market. Often, this includes adding new features that facilitate its use or provide additional advantages to the user.
Organizational	They refer to the introduction of new organizational solutions into an enterprise, concerning business operations, workplaces, or collaboration with external environment. These innovations also relate to all aspects of management, including planning, motivation, decision-making, and control. Organizational innovations result from strategic decisions made by the management of a given enterprise.
Marketing	They relate to changes in marketing strategy aimed at improving the satisfaction of customer needs. These involve a new marketing method that may include changes in product design, packaging, or in the positioning, promotion, or pricing of the product. Marketing innovations are typically part of a new marketing strategy that significantly differs from the methods previously used by the enterprise.
Process	They are associated with the introduction or modification of production, distribution, and service delivery methods.
Technological	They refer to the use of various new technological processes within an enterprise, the main objective of which is to improve or accelerate production and enhance working conditions.

Source: own study based on Oslo Methodology.

Universities and other research institutions hold significant potential for generating innovations. In this context, the transfer of knowledge and technology, as well as the ability to build relationships with the economic environment, are particularly important. The effectiveness of universities' entrepreneurial activities is influenced by multiple factors, including the characteristics of the institution itself (including its management practices)

(Algieri et al., 2013), market and technological uncertainty, national institutional conditions, state and regional policies, and the structure of the regional and global economy (Ambos et al., 2008). Technology transfer centers, together with spin-off enterprises, academic business incubators, and career offices, are considered part of the innovative infrastructure supporting academic entrepreneurship. Academic entrepreneurship refers to the process of creating and managing new ventures based on technology or knowledge developed through academic research. It involves the use of intellectual property and knowledge generated within the academic environment to create commercial opportunities and generate economic value (Poznańska, 2014). Through activities related to technology transfer and the commercialization of research outcomes, academic institutions can facilitate the implementation of innovations by enterprises, public administration, and society at large (Piwowar-Sulej, Kwil, 2018). Research on academic entrepreneurship also highlights additional directions, addressing various aspects of this complex phenomenon (Friedman, 2002; Li, 2009), including its impact on regional development (O'Shea et al., 2004) and its role as a catalyst for innovation (Etzkowitz, Klofsten, 2005). Clarysse et al. (2011) underline the critical relationship between a university's capacity to operate entrepreneurially and the presence of academic staff with suitable entrepreneurial characteristics. Nevertheless, there is still a lack of detailed analyses and frameworks describing the generation of creative ideas, their commercialization, collaboration with enterprises, and individual management of implemented products. Another remaining challenge is evaluating the extent to which various initiatives for the commercialization of academic research are effective and genuinely support enterprise innovation (Ambos et al., 2008). Polish universities actively support academic entrepreneurship through a range of initiatives and programs. Many have established technology transfer offices to assist researchers in commercializing their ideas and inventions (Sopińska, Wachowiak, 2016). Funding for the development of academic entrepreneurship and research on innovation is derived both from public resources at the national and regional levels and through collaboration with enterprises. Studies conducted to date, including research at the Bydgoszcz University of Science and Technology, indicate persistent barriers to maintaining sustainable relationships between the academic and business environments. Despite some progress, Polish research institutions still need to implement more effective strategies to strengthen their position in academic entrepreneurship. A key factor in further developing this area is researchers' experience in securing business partners to finance successive stages of commercializing innovative ideas developed in university laboratories, as well as the support provided by units such as Technology Transfer Centers. In Poland, most research projects are concentrated in engineering and technical disciplines, consistent with international statistics showing that around 50% of research and development expenditures are allocated to these fields. Natural sciences occupy the next position, receiving approximately 23% of funding in recent years. A notable strength of the innovative ideas undertaken by researchers at the analyzed institution was their high degree of uniqueness. Makieła (2017) emphasizes that an

entrepreneurial and innovative university requires a new management model aimed at effective collaboration with national and international partners. Such a university conducts research with commercialization potential, and academic staff, students, and graduates are motivated to take on competitive challenges, with entrepreneurship forming an integral part of the academic culture. Research on academic entrepreneurship indicates that most researchers do not possess all the skills required to act as entrepreneurs. Supporting the innovation process through technology transfer centers and achieving outcomes in the commercialization of research projects is therefore an effective way to address these gaps. Another key research direction, identified by the project team, is analyzing enterprises' demand for innovations and preparing appropriate responses by the university. Disseminating the project results also serves to promote inventiveness and is accompanied by an information campaign outlining the principles and scope of Bydgoszcz University of Science and Technology's cooperation with business environment.

3. Project objective. Selection of research methods.

The project aims to identify and redesign the collaboration processes between Bydgoszcz University of Science and Technology and its socio-economic environment. To achieve this aim, the project has defined the following specific objectives: to determine the factors that enhance activity and competitiveness in the scientific sector; to increase the number of enterprises implementing innovative solutions generated through university–enterprise cooperation; to stimulate the development of pro-innovation solutions in enterprises in partnership with the Bydgoszcz University of Science and Technology; and to conduct benchmarking to identify best practices in innovation transfer and commercialization. To achieve these objectives, the project involved a comprehensive analysis of secondary sources, including literature, statistical databases, and published research on innovation, technology transfer, commercialization, and university-enterprise collaboration, alongside empirical research based on primary data collected specifically for the project through quantitative and qualitative methods. Disseminating the project results also serves to promote inventiveness and is accompanied by an information campaign outlining the principles and scope of Bydgoszcz University of Science and Technology's collaboration with the business environment.

In the first stage of the project, a representative survey was conducted among enterprises in the Kuyavian-Pomeranian region. Two purposively selected samples were used, each meeting minimum size requirements. The first sample comprised small and medium-sized enterprises, while the second included large enterprises. The samples were proportionally stratified according to the number of entities in the manufacturing, service, and trade sectors. Subsequent

stages of the survey involved developing questionnaires for both small and medium-sized and large enterprises, testing the questionnaires, contacting enterprises to collect empirical data, verifying the accuracy of the collected responses, and refining the questionnaires.

In 2023, there were 220,848 business entities registered in the REGON system in the Kuyavian-Pomeranian region, of which 212,822 were micro-enterprises. Given their large number and inherent instability, micro-enterprises were excluded from the planned survey. Experience to date also indicates that micro-entities have a limited role in driving innovation, often acting as followers. Technical, product, and organizational innovations in micro-enterprises were constrained by their small scale and limited financial and human resources. Although these changes were new for the enterprises themselves, they were not novel overall. The quantitative research was carried out using a survey of enterprises in the Kuyavian-Pomeranian region. Two purposively selected samples were defined: the first including small and medium-sized enterprises, and the second including large enterprises, with proportional stratification according to the number of entities in the manufacturing, service, and trade sectors. As of the end of April 2023, 7,817 small and medium-sized enterprises were registered in the region, with an estimated sample size of 367, while 209 large enterprises were registered, with an estimated sample size of 66.

The survey included 433 respondents (Table 3). Over half of the participants were owners of service enterprises (52.7%), while one-third represented manufacturing enterprises (33.7%). Small enterprises constituted the largest share of the sample (60.5%), followed by medium-sized enterprises (24.2%) and large enterprises (15.2%). The majority of surveyed companies had been operating in the market for more than 15 years (81.8%).

Table 3.
Structure of surveyed enterprises

Business sector	% of total	Enterprise size	% of total
manufacturing	33.7%	small (10 to 49 employees)	60.5%
trade	13.6%	medium (50 to 249 employees)	24.2%
services	52.7%	large (250 or more employees)	15.2%
Total	**100%**	**Total**	**100%**

Source: own study.

4. Level of innovation in enterprises in the Kuyavian-Pomeranian region – research results

Table 4 presents the types of innovations introduced by enterprises over the past two years. Product innovations were the most frequently reported, at 48.3%. Process innovations, involving changes in the production of goods or the delivery of services, accounted for 21.7%, while organizational innovations, such as modifications to organizational structure or

management methods, represented 21.2%. Marketing innovations, including new marketing strategies or changes in promotional approaches, were the least common, reported by 14.1% of enterprises.

Table 4.
Types of innovations introduced by enterprises in 2023-2024 (N = 433)

Type of innovation	Percentage
Product (introduction of new products or services)	48.3%
Process (changes in the production of goods or delivery of services)	21.7%
Marketing (new marketing strategies or changes in promotional methods)	14.1%
Organizational (changes in organizational structure or new management methods)	21.2%

Source: own study.

The majority of innovations were developed independently by the enterprises themselves (Table 5). Organizational innovations had the highest rate of internal development (93.5%), followed by product innovations (90.4%), marketing innovations (88.5%), and process innovations (75.5%). Collaboration with other domestic or international partners was most relevant for process innovations (24.5%). None of the innovations were solely developed by other domestic or foreign entities.

Table 5.
Independent development of innovations in enterprises

Type of innovation	Product (N=209)	Process (N=94)	Marketing (N=61)	Organizational (N=92)
Developed independently by the enterprise	90.4%	75.5%	88.5%	93.5%
Developed by the enterprise in collaboration with other domestic or international entities	9.6%	24.5%	11.5%	6.5%

Source: own study.

Table 6 presents the types of financing used by enterprises to support innovation. Internal funds were the most commonly used, accounting for 95.2% of responses. Domestic funding from public institutions was the second most frequent source (11.0%), while foreign non-repayable funds (3.8%) and loans or other financial liabilities from financial institutions (1.4%) were much less commonly used. These results indicate that enterprises primarily relied on self-financing to implement innovations.

Table 6.
Types of financing used by enterprises to support innovation (N=291)

Source of financing	Percentage
Internal (own) funds	95.2%
Domestic funding obtained from public institutions	11.0%
Foreign non-repayable funds	3.8%
Loans, credits, and other financial obligations from financial institutions	1.4%
Other	1.7%

Source: own study.

The majority of innovations were new only for the enterprises themselves, as reported by 81.4% of respondents (Table 7). Innovations new to the national market were reported by 13.4%, and to the European market by 3.4%. Globally novel innovations accounted for 1.0%, while breakthrough innovations, characterized by an exceptional degree of originality, appeared in only 0.7% of cases.

Table 7.
Novelty of changes introduced by enterprises in 2023-2024 (N=291)

Novelty of the innovation	Percentage
New for the enterprise	81.4%
New to the domestic market	13.4%
New to the European market	3.4%
New to the global market	1.0%
Breakthrough innovation	0.7%

Source: own study.

5. Conclusions

The transfer of innovative solutions between science and industry is expected to play an increasingly important role. The intensification and improvement of this process require the active involvement of all actors, including research institutions and commercial enterprises. The volume and pace of innovation implementation call for additional support, particularly in the large sector of small and medium-sized enterprises, which, due to limited resources and operational scale, often lack the infrastructure and human capital needed to conduct research on new solutions.

The percentage-based results of the enterprise survey in the Kuyavian-Pomeranian region indicated that companies strongly recognized the need to implement innovations, although collaboration in this area remained very limited. Product innovations were the most frequently reported type. The vast majority of innovations were developed internally by the enterprises, with independent development reported across nearly all categories, most notably for organizational changes (93.5%), as well as product (90.4%), marketing (88.5%), and process innovations (75.5%). Enterprises predominantly financed innovations from internal resources, which accounted for 95.2% of all responses. Some concern was raised regarding the novelty of the implemented changes, as the majority of innovations were new only to the enterprise itself (81.4%), and far less frequently new to the national (13.4%) or European (3.4%) market. These findings indicate a relatively low level of originality, reflecting a high degree of imitation necessary for maintaining market position.

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