The Role of Regional Technology Observatories in the Creation of a Regional Knowledge Management System

Sławomir Olko, Anna Horzela-Miś and Lilla Knop
Silesian University of Technology, Poland

slawomir.olko@polsl.pl
anna.horzela-mis@polsl.pl
lilla.knop@polsl.pl

Abstract: The main purpose of this article is to present the concept of a regional knowledge management system (RKMS) and the role of regional technology observatories in creating such a system. The commencement of conceptual work on an RKMS results from the need to practically embed the functioning of regional technology observatories in the Silesian Voivodeship in the broader context of managing the development of the region. The formal role of regional technology observatories in the Silesian Voivodeship in shaping the RKMS can be indicated since 2013, when the Network of Regional Specialist Observatories (NSRO) was established. The method used in the article was case study. Based on analyses of the literature, the characteristics of RKMS were identified and then, using data from 2010 to 2024, the NRSO was described and the characteristics of RKMS that NSRO met were identified. The article identifies the directions of development of RKMS and indicates the conditions favourable to endogenously rooted specialisations in the region, which have development potential in a global perspective. As an example of the scope of knowledge acquired by observatories, the results of research in the materials production and processing sector regarding innovation management and business models in this sector were presented. The example uses a quantitative analysis in which data was collected during direct surveys of companies. The research sample covered n=50 companies in the manufacturing and materials processing sector.

Keywords: Knowledge management system, Region, Technology, Technology observatories

1. Introduction

The regional knowledge management system (RKMS) has different features than the enterprise system. The region can be treated as a specific organisation that implements all management functions (planning, organising, motivating, and controlling) for its stakeholders: businesses, scientific institutions, cities, and other organisations (Zhao&Ordoñez de Pablos, 2011).). The nature of knowledge management processes in RKMS remains the same as well-known SECI model (Nonaka&Takeuchi, 1995) but the knowledge transfer takes place between different people in different organisations. The regional authorities are not the only recipients of knowledge created and used in the region. Regional businesses, scientific institutions, and local authorities are actors in this system by actively participating in knowledge exchange processes.

The purpose of the paper is to present specific features of the RKMS using the example of the system operating in the Silesian Voivodeship and the role of Regional Technology Observatories operating under the auspices of the regional authorities.

2. Literature Review

Knowledge management involves identifying, acquiring, collecting, storing, and sharing knowledge. The definitions of knowledge management emphasise the process of its flow and transformation, and management is especially about conscious and purposeful processes (Probst et al., 2000; Davenport and Prusak, 2000; Wallace, 2007; Jashapara, 2004). As part of the knowledge management process in an organisation, we take into account processes that go beyond the boundaries of the organisation (knowledge acquisition, knowledge sharing) as well as processes of informal knowledge flow. This is a significant challenge for knowledge management systems and is even more pronounced in the case of regional knowledge management systems.

Knowledge management systems (KMS) are often reduced to ICT systems that support the management of explicit knowledge, while they should facilitate the natural process of transferring both explicit and tacit knowledge. In the literature, we can indicate examples of KMS implementations for the public sector (Nor'ashikin et al., 2024).

RKMS should have a specialisation that strategically defines what knowledge it concerns and who is the most important end-user of this knowledge. Sardjono et al. (2024) present the evaluation model of RKMS for addressing natural disasters in Indonesia. The main recipient of knowledge in this case is the National Disaster Management Agency (BNPB) in Indonesia. Similarly, Calvani (2010) describes the need for the creation of RKMS in the area of new threats and methods to limit these risks. The Interregional Crime and Justice Research

Institute of the United Nations (UNICRI) established regional knowledge management systems with the objective of facilitating the flow of information among states, using existing knowledge and data to develop common strategies and response mechanisms. In this case, the term "regional" refers to the global region of eastern Europe.

There are many similarities between the regional knowledge management system (RKMS) and the regional innovation system (RIS). Ph. Cooke described the essence of the regional/national innovation system that serves to provide knowledge to entities in the region/country. Of particular importance is the problem of transferring knowledge from scientific units to enterprises, which has been discussed for decades (Cooke, 2004). It should also be noted that, in addition to the knowledge management system, RIS also includes innovation infrastructure, i.e., innovation support entities administered by local and regional authorities. The core of the regional innovation system is the creation, transfer and application of scientific and technological knowledge to promote the regional knowledge innovation, technological innovation, knowledge dissemination and application among the regional entities.

Zhao and de Pablos (2011) present the theoretical assumptions of RKMS from the point of view of core management functions: planning, organising, leadership, and control. According to the authors, there are the following activities that the RKMS fulfils, linked to the core management functions.

1. Planning

- *Basic scientific research programme*
- *Technology foresight programme*
- *R&D programme*
- *Science and Technology Cooperation Programme*

2. Organising – stimulating and coordinating cooperation between actors of the regional innovation system
3. Leadership – Governing role in regional knowledge flow by establishing infrastructure for regional knowledge creation, diffusion, and storage
4. Control

- *identifying failure issues within the region in terms of main knowledge production and knowledge market exchange;*
- *Identifying failure issues of knowledge exchange*

The role of the government is to provide a good learning and innovation environment, build an innovative atmosphere, and create systematic conditions for regional innovation. We are therefore dealing with real aspects (objects) and ephemeral phenomena such as knowledge transfer. To describe the processes that take place between tangible and intangible creations, Czarniawska's concept of ‘action net’ is the best one (Czarniawska, 2004). RKMS is thus an action net that involves the creation, transfer, storage, and sharing of knowledge to create value in the region. S. Olko described action nets in creative clusters, identifying the main interrelated activities and the relationships between them (Olko, 2023).

One of the valuable instruments providing knowledge about technological development is the technology observatory. The Technology Observatory on the regional level is the undertaking, the purpose of which was to win and deliver knowledge on development of technology to the major stakeholders of regional development: regional authorities, companies established within a given region, and institutions cooperating with companies. The organisational form of technology observatory may correspond to differentiated configuration of entities composing the regional innovation system: it may be hierarchical, heterarchical (network form), polycentric, and it may also have dual nature, i.e. have some hierarchical and heterarchical features (Cooke et al. 1997).). The concept of technology observatories comes from the European Key Enabling Technology (KET) observatories (European Commission, 2015).

3. Network of Regional Specialist Observatories as an Instrument of Regional Knowledge Management System

The Network of Regional Specialist Observatories (NRSO) was established on 13 March 2013 as part of the system project of the Marshal's Office of Silesian Voivodeship entitled 'Management, implementation and monitoring of the Silesian Voivodeship Regional Innovation Strategy' (3rd edition) carried out from 2011 to 2013 in partnership with the Silesian University of Technology in Gliwice, the University of Economics in Katowice, the

Central Mining Institute and the TECHNOPARK Gliwice Science and Technology Park).). NRSO operates on the basis of an agreement between the Regional Government of the Silesian Voivodeship and the Partners responsible for the individual technological areas of regional specialisation identified in the "Technology Development Programme for the Silesian Voivodeship". This has created a permanent platform for cooperation between key participants in the region's innovation ecosystem, enabling the implementation of activities to build and strengthen innovative potential. The leader of the network is the self-government of the Silesian Voivodeship, which ensures continuity and effectiveness of activities undertaken within the NRSO.

The following tasks were identified during the development of the NSRO, which the partners will be required to carry out:

- Gathering information and data necessary for the region's authorities to diagnose the potential in a given technological area.
- Monitoring and evaluating the impact of public interventions on the development of a technological area.
- Acting as an animator and advisor for enterprises, units supporting the technological development of the region.
- Organising/co-organising events and meetings.
- Involvement in cooperation with other national and foreign observers.

Figure 1 shows the structure of the NRSO with each observatory not being a separate organisational entity, but an activity assigned to an observatory leader. The Marshal's Office is the Leader of the whole network, coordinating the activities of the network and acquiring projects to ensure its continuity. At the core of the network are three coordinating bodies: Steering Committee, Silesian Innovation Council, Programme Council of the Observatory Network.

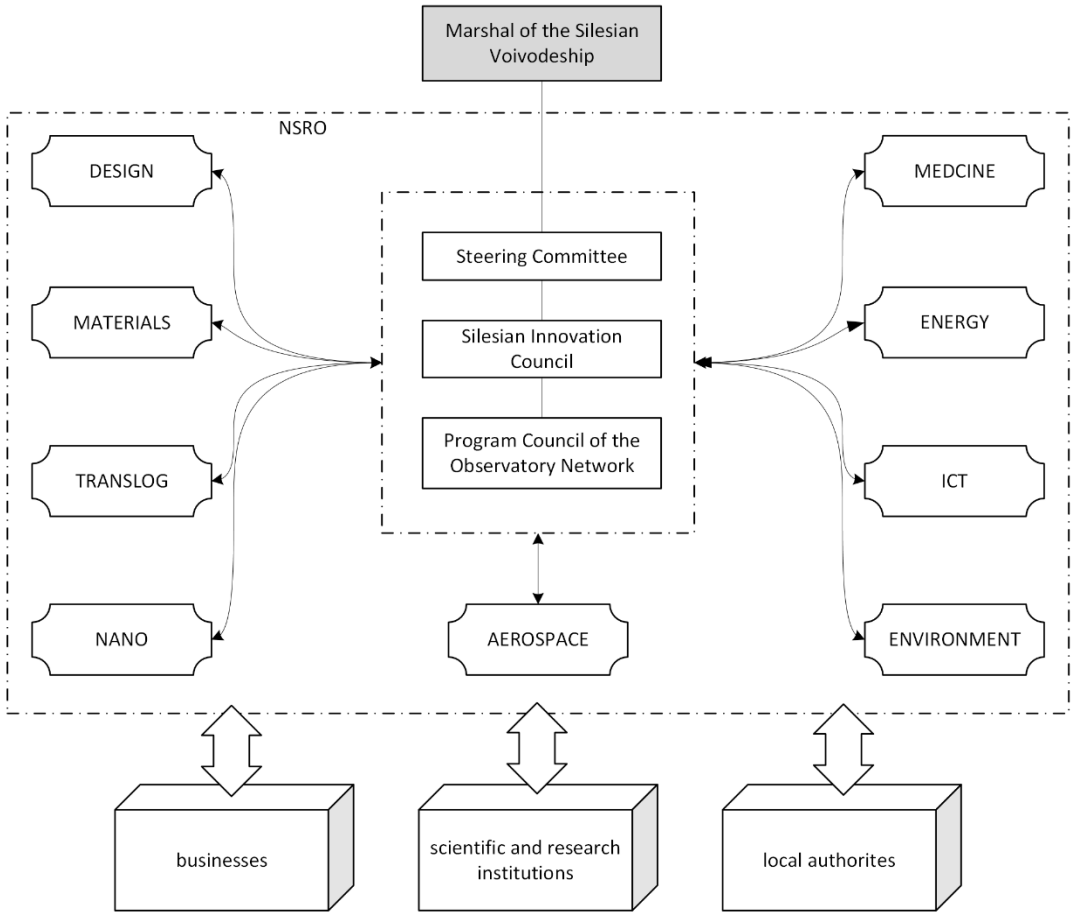

Figure 1: Structure of the Regional Knowledge Management System – example of the Network of Specialist Regional Observators. Source: Own elaboration

The Steering Committee is made up of 32 people representing all the institutions involved in the NSRO, led by representatives of the Marshall Office. The committee comprises representatives from eight universities, five research institutes, and three business environment institutions. Silesian Innovation Council consist of 28 members and 13 external experts. As with the steering committee, they represent the regional scientific and business environment institutions.

The network currently has nine specialised observatories in the technological areas shown in Figure 1. The observatories are consortia of partners with a separate leader, a scientific research institution or a business environment institution. Each observatory is contractually obliged to prepare biannual reports on the state of development of the technology area. This report includes, in particular, information on ongoing projects, regional scientific and research resources within the technology area, identification of regional trends, and recommendations for further development of the technology area. This information is obtained from the business sector and scientific institutions.

4. Knowledge Gained by NSRO - Research in Environments Where Technologies are Used

One of the main objectives of the NSRO is to gather information related to broadly understood innovation management models, the state of innovativeness of enterprises and the needs for support in gaining and implementing innovations, mainly from the public sector. Each of the nine observatories presented in Figure 1 prepares its scope of research in environments that use technology. As part of a project supporting the network's activities in 2023, a survey was conducted of companies operating in the technological area of materials production and processing. The research was carried out by the observatory in this technological area MATERIALS), which is run by a research team at the Faculty of Organisation and Management of the Silesian University of Technology in Gliwice. The subject of this research was innovation management, business models, innovation application, strategy and organisational structure, development of human resources, and the impact of innovation on the functioning of the company. The results of this research, i.e. the information and opinions obtained, were a component of the information resources in the regional knowledge management model enabling the creation of instruments to support innovation management and reduce the risk of innovation application. The following research techniques were used in the study:

- diagnostic survey using a research questionnaire addressed to companies in the materials sector,
- multiple case studies (4 companies),
- documentation analysis of the 4 companies under study,
- interviews with managers (4 companies).

In the case of the first method, surveys were conducted in 50 small and medium companies selected in the Silesian Voivodeship. The basic selection criterion was the business activity conducted in the field of production of one of the following: metal materials, plastics, ceramics, and composites. The survey was carried out between 4 May and 24 May 2023 and as result, n=50 completely completed questionnaires were obtained. This sample size corresponds to the minimum sample size determined by the historical method cited by G. Churchill (1995). Historical data suggests that for regional surveys conducted in institutions, with the number of subgroup analyses from 0 to 9, the sample size should be between 50 and 200 entities. According to the Central Statistical Office, the general population of companies in the manufacturing and materials processing sector in the Silesian province includes N=9 771 companies.

The questionnaire contained 32 extensive questions, open and closed, single and multiple choice, and covered the following research areas:

- **General characteristics of the company.** This area provides information on the products (leading activity), markets, ownership structure, scale of capital, revenue, and employment of the surveyed company. We also asked about the implemented management standards (ISO, HCCP, TQM). An important piece of information was the ratio of R&D expenditure to revenue in the last 3 years. The responses were obtained in the form of a constructed percentage scale.
- **Practice in innovation management.** The questions dealt with two important issues.The first was the types of innovation applied in this area: product, process, organisational, marketing, management and social innovation. Given the extended classification of innovations, these concepts were explained to respondents. The second is the sources of funding for the innovation, i.e. loans, own funds , public funds, or other funding. The answers to these questions provide information related to the applicability of innovations and the associated risks.

- **Strategy and business model.** The first part of this area focused on how the different types of innovation related to strategy and its elements, as well as to the business model. Respondents were asked to provide information on both the actual and the postulated (benchmark) state.
- **Organisational structure.** The information obtained was related to the current functioning (or planning of functioning) in the company's management system of a unit or position related to the R&D and innovation process or function. Respondents also assessed the status and intentions of cooperation in technology transfer and innovation.
- **Knowledge management.** In this area, it was important to explore the elements of knowledge management present in the company such as systems, procedures, instruments and tools for knowledge management, concepts and methods used to support knowledge creation, talent acquisition and utilisation, and management of innovative projects. Another important problem in this area was the assessment of risk management. The questions concerned the mapping of risks and the assessment of the importance of different types of risk, including in particular risks related to the impression of different types of innovations.
- **Employees.** The focus was on the aspects of human resource management related to the creation and implementation of innovation. Information was obtained on employee development in the area of research, development, and innovation, as well as on preferences for issues in this area (e.g., design, technology, quality).
- **Needs and expectations of the company towards the administration, cooperation with the environment.** In this area, information was obtained on the entities, subject and scope of cooperation with the environment related to innovation activities in the broad sense. Areas of support expected by public sector enterprises in the implementation of innovation were identified.
- **Self-assessment of innovation management.** The final element of the research questionnaire is a request for respondents to self-assess the management of innovation in their company compared to other companies in the industry researched in Poland. Factors such as cooperation with the environment and the use of public support, innovation project management, or product/process/technology development were valued.

The following section presents analyses of the responses to selected questions from the research survey. The broad scope of the survey research has allowed the acquisition of knowledge in the field of innovation in the manufacturing and materials processing sector, which is an important information feed for the RKMS.

The effects of the company's innovation policy, strategy, and management are the implementation of different types of innovation. Their structure illustrates the specific preferences of the company in the implementation of innovations, which results from the competitive position as well as the possibilities (including financial) of the organisation. Figure 2 presents the answers to the question ‘What type of innovations has the company introduced in the last 3 years?’ which shows that by far the most common innovations introduced were product process innovations, which dominated in 80% and 66% of the surveyed enterprises, respectively. The primacy of product innovations results from the frequent use by SME enterprises of strategies to distinguish themselves with products meeting customers' expectations, used by them for further processing. The need to implement product innovations is also influenced by the requirements set by corporations in cooperation chain systems. The importance of using process innovations is justified by the nature of the sector (production of materials), where new technologies enable the creation of innovative products but also affect cost competitiveness by reducing direct costs, i.e. materials, raw materials, energy, and labour.

Interest in process innovations is also influenced by the requirements and principles of a sustainable economy. Marketing and organisational innovations were implemented to a lesser extent, reaching the same level, that is, 36% of the companies surveyed implemented this type of innovation. Even taking into account the fact that 24 % of enterprises use management innovations, the share of this type of innovation, i.e. directly related to the market (customers) and management, is not satisfactory. A positive phenomenon is the relatively moderate interest in social innovations, reaching 20% of the surveyed enterprises. This situation is a signal for a broader recognition of the potential of this type of innovation, the importance of which in the development of a sustainable economy is constantly growing.

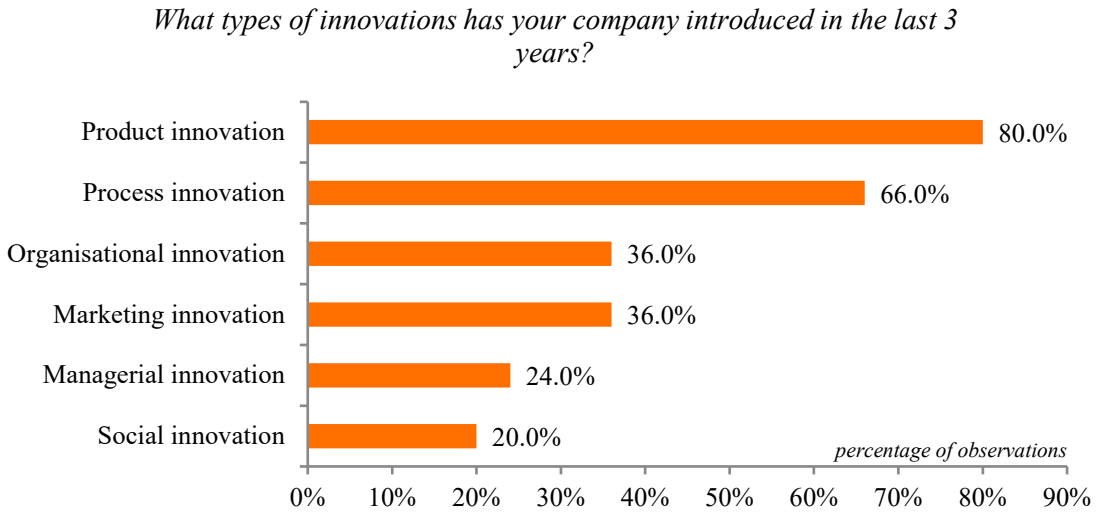

Figure 2: Types of innovations introduced by companies in the material production and processing sector (more than one indication possible, n=50). Source: Own elaboration

The issue of the relationship and direct reference of innovations to different areas of the company's operation arises from the very nature of innovations and the use of innovations in management. Information on this phenomenon is included by referring both to the actual state and the preferred state. Therefore, Figure 3 shows the responses of the respondents to the question 'In what areas of the company's activity are there direct references to innovation?' while Figure 4 shows the answers to the question *'In which areas of the company's activity should there be direct references to innovation?'*. In the first case, the vast majority (26 to 33) of respondents considered important the links between innovation and strategic management, i.e., goals, mission, vision, strategic analyses, and the company strategy itself. Fewer than half of companies see references to innovation in business models (22). In addition, less than half of the companies refer to business models (22), procedures, process maps (24) and organisational structures (25), i.e. elements of operational management. Relatively few respondents (14) see links between innovation and the use of key performance indicators (KPIs).

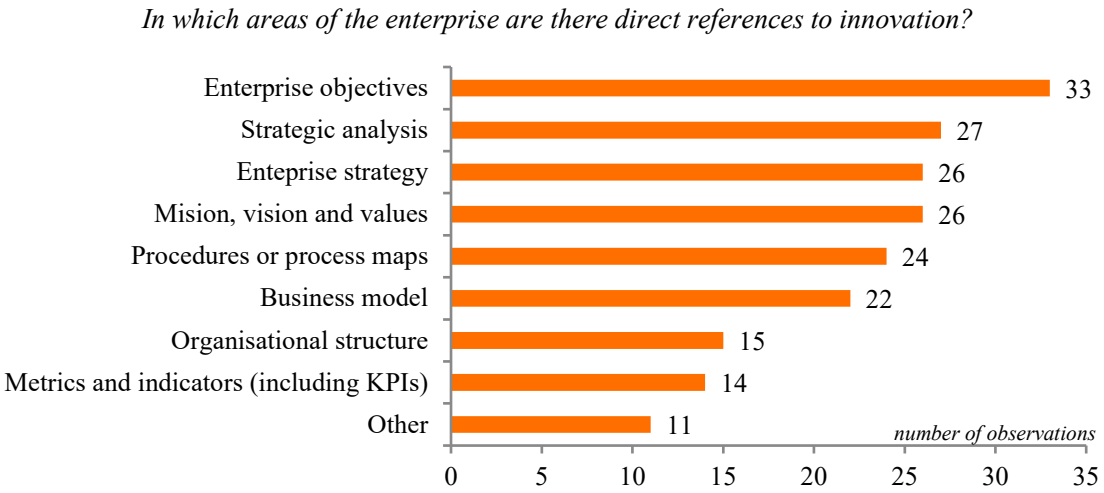

Figure 3: Business areas with direct references to innovation (n=50). Source: Own elaboration

This shows that there is little belief in companies in improving operational management, applying innovation to the construction of business models and using them as innovation vehicles. When analysing the responses related to the postulated state (benchmark), as shown in Figure 4, one can see a significant increase in the number of respondents perceiving a link between innovation and the strategic management of the company. The importance of innovation in the formulation of objectives is perceived in 40 companies, representing 80% of the entire research sample. Also, many enterprises (more than half) link innovation with strategy, mission, vision, values. The number of indications of links between innovation and process management (29), business

models, and organisational structure has also increased. Less than half (21) of the companies surveyed see links between innovation and business measures and indicators, including KPIs. This indicates an insufficient appreciation of the role of innovation in increasing organisational effectiveness and enterprise value.

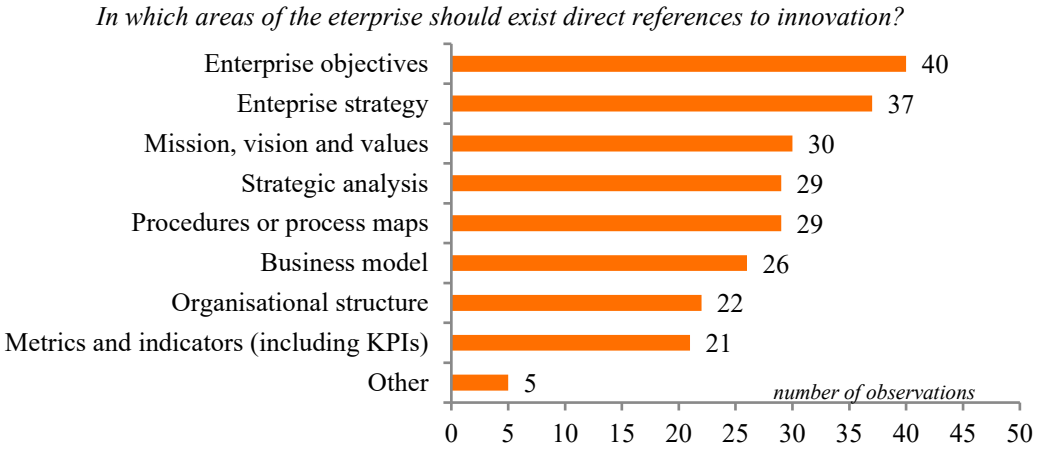

Figure 4: Areas that should have direct references to innovation (n=50). Source: Own elaboration

The issue of measuring innovation more broadly is characterised by two research questions:

- What innovation-related indicators/measures are used in your company ?
- Which innovation-related indicators/measures should be used in your company?

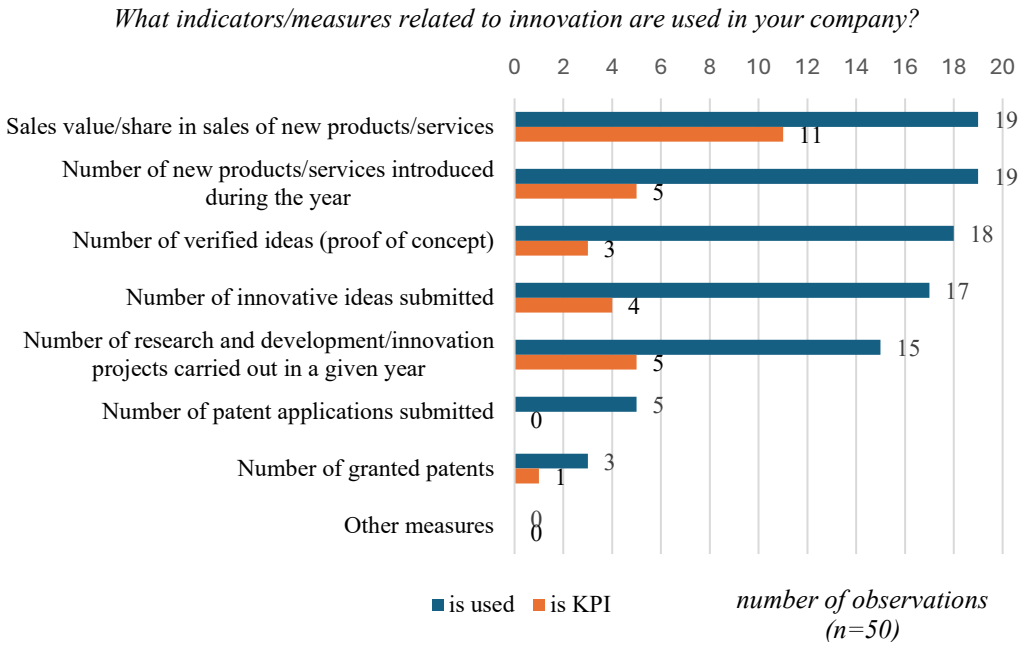

Figure 5: Areas where direct references to innovation should exist. Source: Own elaboration

The structure of the answers to the first of these questions is shown in Figure 5 and the second in Figure 6. The analysis of the answers shows that the use of outcome measurement for applied innovation is not common in companies. Among the companies that use outcome measurement of applied innovations, the most important are:

- value of sales/share of sales of new products is used by 19 companies and is considered a key performance measure by 11 companies,
- The number of new products (services) introduced during the year is used by 19 enterprises; 5 enterprises consider it as a key performance indicator (KPI).

A relatively large number (15) of companies use the number of research and innovation projects implemented to measure innovation. Analysis of the data in Figure 4 indicates a rare use of key performance measures for innovation activity. In the case of answers to questions concerning the desired state, more enterprises are in favour of using measures characterising innovation activity. More than half (29) of the companies surveyed postulate the use of sales value/share of sales of new products as a measure, but only 10 consider it as a key performance measure. Almost half (24) associate the number of validated ideas and the number of research and innovation projects carried out during the year with innovation. More than 20 companies opt for the use of the number of ideas submitted and new products introduced during the year to measure innovative activity.

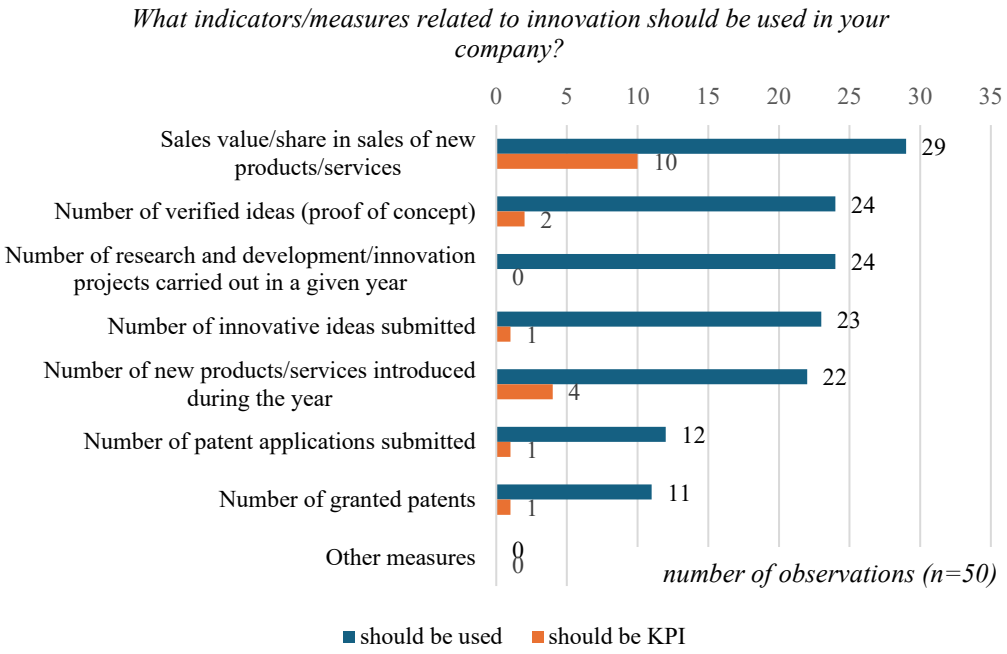

Figure 6: Indicators or measures related to innovation that should be used in investigated enterprises. Source: Own elaboration

Analysing the responses to the questions (Figure 6), it can be seen that very few respondents postulate the use of key performance indicators (KPIs) for innovation activities, indicating little interest and appreciation for innovation in corporate value management and little orientation towards motivating employees to innovate internally through the use of the Balanced Scorecard.

The problems of financing research, development and innovation activities are framed by the following research question: *'What percentage of revenue in your enterprise is allocated to research, development and innovation?'* The answers to these questions are captured in Figure 7. Nearly half (24) of the surveyed companies allocate less than 1% of their revenues to R&D&I of which 10 i.e. as many as 20% of the surveyed companies do not finance innovation in this way at all. In turn, 1% to 2% of revenues are allocated to R&D&I by 5 companies , from 3% to 5% it is 10 companies, 9% -10% are spent on this activity by 4 companies, and only one company declares financing this activity from revenues at the level of more than 10%. The results of the surveys clearly indicate a relatively low level of financing of R&D&I activity from own resources (revenues) of enterprises, which can be justified by awareness of high risk related to innovative activity. The information obtained may be used in the Regional Knowledge Management System as a premise for a policy that supports innovative activity, especially in the SME sector. It should be noted that in each technological area, the specifics of innovation activity may be different, hence the need for individualised research.

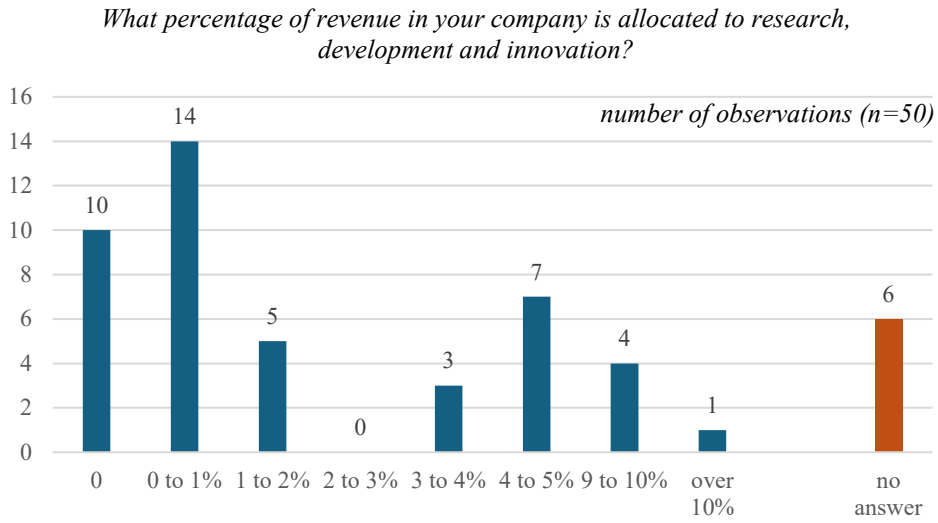

Figure 7: Percent of revenue allocated to research, development, and innovation (R&D&I) of the surveyed companies. Source: Own elaboration

5. Conclusions

Based on the analyses of the literature and the descriptive analysis carried out of NSRO operation as RKMS so far, the following conclusions may be drawn.

- NSRO meets the requirements for RKMS described in the literature, despite the fact that it concerns a narrow thematic scope, i.e. the innovation management in entities creating the regional smart specialisations.
- The most important functionality of the regional knowledge management system is to provide regional decision makers with knowledge about the needs of enterprises in the area of innovation management.
- Practical experience of the NSRO's operation indicates that it covers only a small part of regional innovation knowledge, but such systems should nevertheless be developed in order to rationalise decisions at regional level.
- The article presents an example of the knowledge collected by an exemplary observatory relating to the diagnosis of the current state of the region. Since 2024, observatories of NSRO have also been used to carry out technology foresight for selected technological areas. This is therefore a new functionality of the NSRO, which is part of the framework of the RKMS.
- Further development of the NSRO may involve improving and developing new tools for sharing knowledge with regional partners and developing tools for sharing tacit knowledge. This will also be a future research task for the authors of this article.

Acknowledgements

The article presents selected results of the regional project “Creation of Regional Innovation Observatory”. The project is financed by the project is financed by the European Funds for Silesia program and state budget (project number: FESL.01.03-IP.02-06CF/23).

Ethics and AI declaration: Ethical clearance was not required for the research presented in the article. No AI tools were used in the creation of this article.

References

Calvani, S. (2010) Geopolitical Overview: Safety and Security in Western and Eastern Europe with Particular Reference to New Trends. Highlighting New Threats and an Innovative Approach to the Necessary Regional Knowledge Management Systems. [in:] Brugnoli, A., Dangerous materials: Control, Risk Prevention, and Crisis Management. From New Global Threats to New Global Responses: A Picture of Transition, Conference proceedings.

Churchill, G. A. (1995). Marketing Research. Methodological Foundations. The Dryden Press, Forth Worth.

Cooke, P. (2004) ‘The role of research in regional innovation systems: new models meeting knowledge economy demands’, Int. J. Technology Management, Vol. 28, Nos. 3/4/5/6, pp.507–533.

Cooke, Ph., Uranga, M.G. and Etxebarria, G. (1997) 'Regional innovation systems: Institutional and organisational dimensions', Research Policy, Vol. 26, pp 475-491.

Czarniawska B. (2004) On Time, Space, and Action Nets. Organization, vol. 11, p. 773-791.

Davenport, T., Prusak, L., (2000) Working Knowledge. How Organizations Manage What They Know., Harvard Business School Press.

European Commission (2015), Key Enabling Technology (KETs) Observatory, second report, December 2015.

Harmaakorpi, V., Melkas, H., (2005) "Knowledge Management in Regional Innovation Networks: The Case of Lahti, Finland." European Planning Studies Vol. 13, No. 5, DOI: 10.1080=09654310500139277, pp. 641-659.

Jashapara, A. (2004) Knowledge Management: An Integral Approach. Prentice Hall.

Nonaka, I. and Takeuchi, H., (1995) The knowledge creating company: How Japanese companies create the dynamics of innovation. New York: Oxford University Press.

Olko, S. (2023) From networks to action nets: knowledge management in networks and clusters in creative industries in Poland. Scientific Papers of Silesian University of Technology, Organization and Management Series no. 177, pp. 447-463, DOI:10.29119/1641-3466.2023.177.26

Nor'ashikin, A., Musyazid, M.M., Alkawsi, G., Capretz L.F. (2024) If you build it, will they come? Exploring the success factors of knowledge management systems in the Malaysian public sector. Helyion no. 10., https://doi.org/10.1016/j.heliyon.2024.e27093

Probst, G., Raub, S., & Romhardt, K. (2000). Managing knowledge: building blocks for success. John Wiley & Sons.

Sardjono, W., Maryani, Retnowardhani, A., Lusia, E., Zarlis, M., Perdana, W.G. (2024) "Evaluation Model of Urban Regional Knowledge Management Systems in Indonesia for Natural Disaster Mitigation" 6th International Conference on Cybernetics and Intelligent System (ICORIS), http://dx.doi.org/10.1109/ICORIS63540.2024.10903773

Soriano, A.S., Álvarez, C.L. & Torres Valdés, R.M. (2018) "Bibliometric analysis to identify an emerging research area: Public Relations Intelligence—a challenge to strengthen technological observatories in the network society." Scientometrics, Vol. 115, pp 1591–1614 https://doi.org/10.1007/s11192-018-2651-8.

Wallace, D. P. (2007) Knowledge management: historical and cross-disciplinary themes. Libraries Unlimited, London.

Zhao, J. and Ordoñez de Pablos, P. (2011) "Regional knowledge management: the perspective of management theory", Behaviour & Information Technology, Vol. 30, No. 1, pp 39-49.