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INNOVATION STRATEGIES AND BUSINESS MODELS OF MATERIAL PROCESSING SECTOR ENTERPRISES IN THE SILESIAN VOIVODESHIP

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Purpose: The aim of this study was to identify the specific characteristics of innovation strategies and business models of selected material production and processing companies in the Silesian Voivodeship in the context of the innovations they have implemented.
Design/methodology/approach: The diagnostic survey method, employing research questionnaires and multiple case studies, made it possible to assess the importance of various types of innovations in introducing changes to the strategies and business models of the analyzed enterprises in order to enhance their competitiveness, operational efficiency, and business resilience.
Findings: Companies in the materials production and processing sector adapt their innovation strategies to market requirements by offering a specific combination of values to the customer. The results of the research indicate that companies very often apply product and process innovations.
Research limitations/implications: The most significant limitations of the study relate to its sectoral and regional focus, as well as the fact that it was conducted on a relatively small sample size. Research in the field of innovation management is relevant and timely due to the fact that the production and processing of metallic and non-metallic materials remains an important industry in Poland, supplying its products to many sectors of the economy.
Practical implications: The results of the research can be used in the Regional Knowledge Management System to stimulate innovation as part of the Regional Innovation Strategy implementation.
Originality/value: The article highlights the importance of innovation in the materials production and processing sector, which is not typically identified as innovative. It presents the nature of innovation strategies and business models in this sector.
Keywords: innovation strategy, business model, material sector.
Category of the paper: research paper.

1. Introduction

Intensifying global competition, particularly from East Asian countries, dynamics of changing customer needs, and adherence to the principles of sustainable economy constitute the primary reasons for changes in the strategies and business models of enterprises operating in the metallic and nonmetallic materials processing sector. These changes are largely oriented toward the use of various types of innovations, i.e., process, product, marketing, organizational, social, and environmental innovations, enhancing competitiveness through the implementation of economic and market objectives and values as well as social and environmental goals. The Polish market for metallic, plastic, and ceramic products is fully open, i.e., competitive and, apart from broadly defined environmental regulations (which, within the EU, is self-evident), is not subject to additional regulatory instruments. Competition is therefore global, with large industrial corporations, including foreign companies, acting as dominant players. Alongside them operate small and medium-sized enterprises focused on deep materials processing, innovative, often niche, products (e.g., manufacturing of composites and decorative ceramic products) as well as specialized services. The sector under study is represented by enterprises classified within four divisions of the Polish Classification of Economic Activities (NACE): 22, 23, 24, and 25.

Such a situation constitutes the antecedence for the studies undertaken within the project "Network of Regional Specialized Observatories in the Entrepreneurial Discovery Process in the Silesian Voivodeship", code SO RIS w PPO – II (hereinafter referred to as the Project). The Project involved a study conducted among enterprises operating in the technological sector of materials production and processing. The study addressed issues related to innovation management and business models, the implementation of innovations and strategies, organizational structures, development of human resources, and the impact of innovation on enterprise performance. The study findings are intended to enable the development of instruments supporting the implementation of innovations and reducing the risks associated with them in small and medium-sized enterprises in the Silesian Voivodeship. This article presents the results of a portion of the study, including innovation strategies and business models. The objective of the study was to identify the specific features of innovation strategies and business models adopted by enterprises engaged in materials production and processing in the Silesian Voivodeship. The study conducted among entrepreneurs enabled an assessment of the impact of different types of innovations on changes in strategies and business models. The object of the study was a selected study sample of small and medium-sized enterprises operating in the metallic and non-metallic materials processing sector in the Silesian Voivodeship.

The subject of the study was innovation management in companies, and in particular their innovation strategies and business models. These constitute fundamental elements and instruments of strategic management in modern organizations. The literature on the subject (Zott, Amit, 2013; Knop, Brzóska, 2016; Wirtz et al., 2016; Ritter, Lettl, 2018; Shepherd et al., 2023), the importance of the business model as a key instrument for generating value for the customer and for increasing and maintaining a company's competitiveness is emphasized. In the relationship between strategies, business models, and innovation, one can observe the creation of strategic synergy (Aagaard, 2024), as well as opportunities to develop social and technical architectures and business processes capable of creating new value for both the customer and the company (Prahalad, Krishnan, 2009), which form the foundation of competitiveness and business resilience. Innovation is a key driver of the implementation of new strategies and business models in many companies (Saebi et al., 2017). The rationale for undertaking the presented research was the ever-growing importance of innovative strategies and business models resulting from the dynamics of the environment, but as noted by Aagaard (2024) and Kubiński et al. (2023), this is primarily due to the requirements of a sustainable economy (development) and the rapid growth of the digital economy and the innovation ecosystem. In line with this trend in innovation research, it is worth noting the relatively narrow scope of quantitative studies in Poland concerning innovation management in SMEs operating in specific economic sectors. The present study aims, in part, to fill this gap by presenting the innovativeness of enterprises as reflected in the various types of innovations they have implemented, their impact on strategy and business models, as well as the measurement of the benefits and effects derived from these innovations.

2. Innovation Strategies and Business Models – theoretical approach

In management studies, strategy refers to a long-term plan of action and encompasses all organization's areas. An innovation strategy may be regarded as a functional strategy, as innovation management can be regarded as a key organizational function, similar to marketing, production, human resource management, and finance. Innovations also constitute key elements of organization's strategy; therefore, an innovation strategy of an organization should be perceived not only as a functional strategy but also as a competitive one (Hannah et al., 2019). Pires and Fereira (2025) argue that innovation strategies comprise a range of organizational strategic decisions related to knowledge acquisition sources (in-house development versus external acquisition), the degree of collaboration with other organizations, the extent (incremental or radical), and the type (technological and non-technological) of innovation, as well as funding sources and mechanisms for protecting IP. Based on a systematic literature review, the authors argue that the key decisions in innovation strategy concern the

degree of innovation openness (open, closed, or hybrid) as well as the degree and types of innovations. The latter area refers to the diversity of innovation degrees and types of innovations that may define the essence of an innovation strategy. One of the dichotomies in innovation management described by F. Trompenaars (2010) is the presence of the "hare" and the "tortoise" strategies in organizations. The "hare" strategy involves rapid pursuit of end results, bypassing intermediate issues and projects perceived as non-essential and requiring collaboration with external partners possessing superior competencies. The "tortoise" strategy is based on the systematic accumulation of knowledge necessary to build a core competitive advantage and investing in additional projects providing a foundation for the organization's activity in the future. As a result, the "hare" strategy provides greater dynamics of effects at the beginning of a project, to gradually diminish along with project development. The "tortoise" strategy is characterized by lower dynamics of effects at the beginning of a project, yet, as time progresses, the accumulated knowledge proves valuable in solving emerging problems. Paradoxically, despite their different trajectories, both strategies ultimately lead organizations to the same place - the same strategic position over time. The "tortoise" strategy must rely on long-term relationships with suppliers in the process of new product development. In terms of relationships with the external environment, the dichotomy between the "hare" and the "tortoise" strategies corresponds to the key strategic make-or-buy dilemma. Perron et al. (2005), based on their empirical research conducted in the United Kingdom, found that long-term relationships with suppliers do not appear to play a significant role in the development of radical innovations.

Another important dichotomy in innovation management strategy concerns the openness or closed nature of innovation processes. The traditional model of innovation management is closed and requires entrepreneurs to maintain confidentiality of their solutions and use available forms of intellectual property protection. According to P. Trott, the open innovation model emerged in the early twenty-first century, emphasizing collaboration at every stage of the innovation process – from idea generation (co-ideation), through co-design, to use by prosumers, who are both a source of product-related feedback and new ideas (Trott, 2018). The most prominent author describing open innovations is H. Chesbrough. Two additional areas of innovation, increasingly important to innovation strategies and deserving particular attention are digitalization and so-called green or eco-innovations. Digitalization supports innovation across virtually all industrial sectors and constitutes a significant component of innovation strategies within public organizations (Guenduez et al., 2025). This subject has become sufficiently significant that, in some organizations, one can speak of a distinct digitalization strategy, constituting a component of organization's innovation strategy. In turn, eco- or green innovations, although increasingly present in organization managerial practice, may conflict with the expectations of certain stakeholders (Dong et al., 2026). Over the past decade, the relationships between innovations and business models has been a very important area of both theory and practice in strategic management. These relationships

may be analyzed in terms of two aspects. The first one regards the business model as an original management concept constituting an organizational innovation in its own right, sometimes even taking the form of a breakthrough innovation (Hammel. 2003). Examples include business models using digital economy instruments, startup-type models, and sustainable business models (Jabłoński, Jabłoński, 2023; Brzóska, Szmal, 2017; Szumniak-Samolej, 2022). In advanced sectors of the economy, increasing importance is also attributed to Economy 4.0–based business models (Brzóska, Knop, 2020; Brzóska, Szmal, 2017; Grabowska, 2025). The second aspect of the relationship between innovations and business models concerns the use of various types of innovations for building model structures and, particularly, creating and delivering value to customers. These two approaches to business models are linked by a fundamental element, an attribute and, at the same time, an outcome of business model implementation, namely, the increasingly multidimensional, i.e., economic, social, and environmental value (Schaltegger et al., 2016). Such value is intended to satisfy customer needs or enable the solution of customer's problems and, at its most advanced level, to create prosumer relationships (supplier-customer value exchange). This value is also expected to enable the growth of enterprise value (Teece, 2010; Brzóska, Szmal, 2020), primarily through the retention of a portion of the value creating economic value added (EVA), but also through pro-environmental and pro-social activities. Studies on business models have produced numerous definitions and concepts (e.g., Chesbrough, 2010; Teece, 2010; Amit, Zott, 2017; Osterwalder, Pigneur, 2008; Newth, 2012; Gołębiowski et al., 2008). A business model may be regarded as a configuration of social and technical architecture, along with resilient and flexible processes and projects creating values for the customer and the enterprise. In the context of the research area of this article, particularly important are concepts concerning the creation of value and the importance of innovations in business modeling. The creation of unique, multidimensional value and competitive advantage as well as efficiency is closely linked to innovations, with an innovative business model serving as their primary vehicle. Such a model is understood as a process aimed at reducing costs, optimizing processes, accessing new markets, or improving financial performance (Foss, Saebi, 2017). Within this model, emphasis is placed not only on the importance of product and process innovations but also on the component of systemic change influencing enterprise value growth, the value proposition offered to customers, and the process of value creation. The successful implementation of an innovative business model determines the enterprise's ability to absorb and, subsequently, diffuse innovations, which often enable positive transformation and development of the enterprise (Velu, 2016). A particularly interesting approach enabling the analysis and creation of business models in innovative enterprises operating in the global economy is the concept of the "New Age of Innovation", developed by C.K. Prahalad and M.S. Krishnan (2009). The authors regard the business model as one of the most important elements of an innovation potential of enterprise, serving its transformation. The model is based on the configuration of social and technical architectures combined through business processes. In addition, the authors

emphasize the importance of collaboration and coordination, as well as of crucial links between business processes and ICT architecture, serving as critical support tools, where created values are based on innovations, as can be observed, for example, in the power sector (Brzóska et al., 2022). Usually, the development of an innovative business model is a stimulus resulting from changes in the external environment, e.g., the introduction of a new breakthrough technology (Lee et al., 2019), legal regulations, or social conditions. The concept of sustainable business models combines multiple approaches integrating social and economic value with the business model (Moratis et al., 2018). In general, a sustainable business model may be defined as one whose social and technical architectures, as well as business processes, are oriented toward creating, delivering, and partially capturing value while simultaneously addressing the three key aspects of the value, i.e. economic, social, and environmental. This brief review of innovation strategy and business modeling-related issues highlights the significant dynamics of their concepts and relationships with innovation management.

3. Research Methods

The study involved synthetic analysis of the subject-specific literature and a diagnostic survey conducted using a research questionnaire covering eight research areas. The authors performed a multiple case study involving four selected enterprises. The case study included observation, detailed analysis of documents, and interviews with managerial and specialist staff. The concept of the New Age of Innovation (Prahalad, Krishnan, 2009) was used to characterize the business models of the four companies under study. Innovation management was assessed using the MIOD method (Monitor of Innovative Organizational Development). The survey was conducted among 50 selected small and medium-sized enterprises located in the Silesian Voivodeship. The primary selection criterion was enterprises' production of metals, plastic materials, ceramic materials, or composites. The questionnaire consisted of 32 comprehensive questions, including both open-ended and closed-ended items, as well as single- and multiple-choice questions. The results presented in this article concern the research panel covering the area of innovation strategy and the business model of an enterprise. The study focused on the relationship between various types of implemented innovations with strategies and business models.

4. Empirical Results

The results presented below pertain to the research panel addressing enterprise's strategy and business model. The analysis focused on evaluating the relationships between various types of implemented innovations and strategy and business model. Respondents were asked to provide information regarding both the actual and the desired states. The information concerned referring innovations to various areas of enterprise's activities, as well as indicators characterizing innovations. The authors obtained opinions regarding the impact of implemented innovations on strategy and business models, as well as on the individual components of these fundamental concepts and ideas for business activity enabling competitiveness. The questions were also concerned with the assessment of the impact of innovations on indicators and outcomes (included in a broad list) reflecting the market position, financial performance, technological capability, human resources and knowledge management.

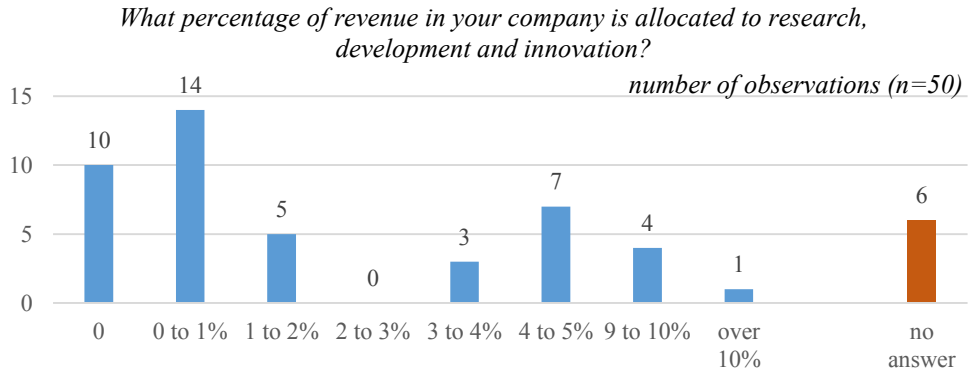

Figure 1. Percent of revenue allocated to research, development and innovation (R&D&I) of the surveyed companies.

Source: own elaboration.

The utilization of innovations, understood as their absorption, implementation, and diffusion, is closely linked to the enterprise's available financial resources. Therefore, a reply to a question concerning the percentage of revenues allocated by enterprises to research, development, and innovations was very important. The distribution of responses to this question is presented in Figure 1. The findings indicate that nearly half of the surveyed enterprises (24) allocate less than 1% of their revenues to R&D&I. Of these, 10 enterprises (representing 20% of the firms) do not finance innovations in this manner. In addition, 10 enterprises (i.e., 20% of the firms) allocate only between 1% and 2% of their revenues to R&D&I. The same number of firms allocate between 3% and 5% of their revenues to development. Only four enterprises (8% of the firms) spend between 9% and 10% of their revenues on R&D&I, whereas just one firm declares spending more than 10% of revenues on these activities. These findings indicate a relatively low level of R&D&I financing from enterprises' own sources, particularly from current revenues, i.e. operating activities. Such a situation may be attributed to awareness of

the high level of risk associated with innovation activities, as well as to the pursuit of external funding sources, including support programs. These findings also highlight the need to identify solutions reducing the risks associated with the implementation of innovation activities by enterprises. The relationships and direct reference of innovations to various areas of enterprise's activities result from the very nature of innovations and their application in both strategic and operational management. The analysis of this issue is presented in relation to the current and the desired states.

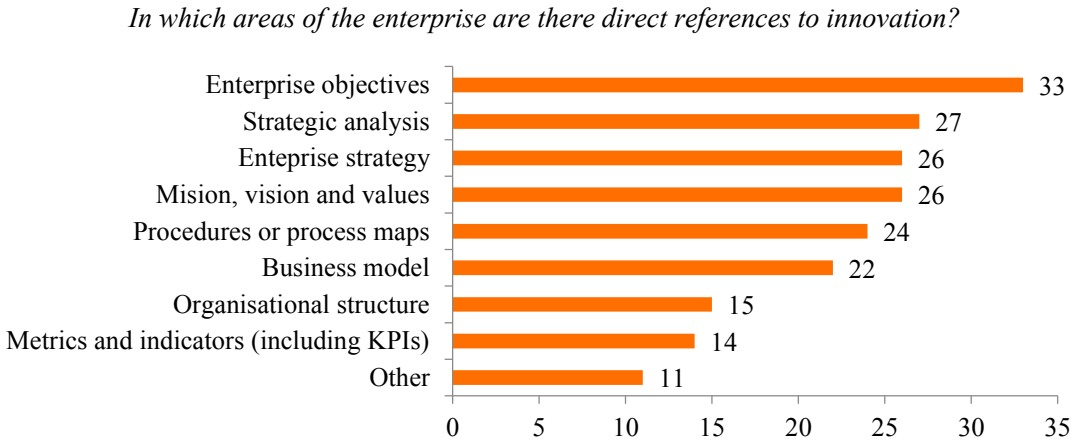

Figure 2. Enterprise areas with the direct references to innovation.

Source: own elaboration.

Figure 2 presents the distribution of respondents' answers to the question regarding the areas of enterprise's activity in which innovations are directly referenced. Figure 3 illustrates the distribution of responses to the question concerning the areas in which such direct references to innovations should be present. With respect to the current state, as many as 33 enterprises (66% of the firms) identified links between innovations and organizational goals as significant. The majority of respondents also recognized important relationships between innovations and fundamental elements of strategic management, such as strategic analysis, corporate strategy, as well as the enterprise's mission, vision, and values. However, fewer than half of the respondents expressed a strong conviction regarding the importance of referring innovations to business models, which suggests a relatively limited interest in applying innovations in such concepts related to the functioning of enterprises. Similarly, fewer than half of the enterprises (24) directly refer innovations to procedures and process mapping or to organizational structures (25), i.e., to elements of operational management. A relatively small number of respondents (14) identify links between innovations and the use of key performance indicators (KPIs). This suggests a limited recognition of the necessity for enhancing operational management using innovations. In turn, the analysis of responses concerning the postulated (model) state, presented in Figure 3, indicates a greater importance of innovations in enterprise management. According to 40 respondents (representing 80% of the total sample), innovations are perceived as playing a significant role primarily in shaping the organisation's goals.

Very many enterprises (approximately 60%) associate innovations with strategy, mission, vision, and the values guiding employees in the enterprise's activity. Compared with the current state, a significant increase (29) was related to the number of indications concerning relationships between innovations and process management, business models and organizational structure, suggesting an appreciation of their importance in operational management. However, fewer than half of the surveyed enterprises (21) identify links between innovations and performance measures and indicators associated with enterprise's day-to-day operations (including KPIs). This indicates an underestimation of the role of innovations in enhancing efficiency and organizational value management, as well as a relatively low application of the Balanced Scorecard in organizational management systems.

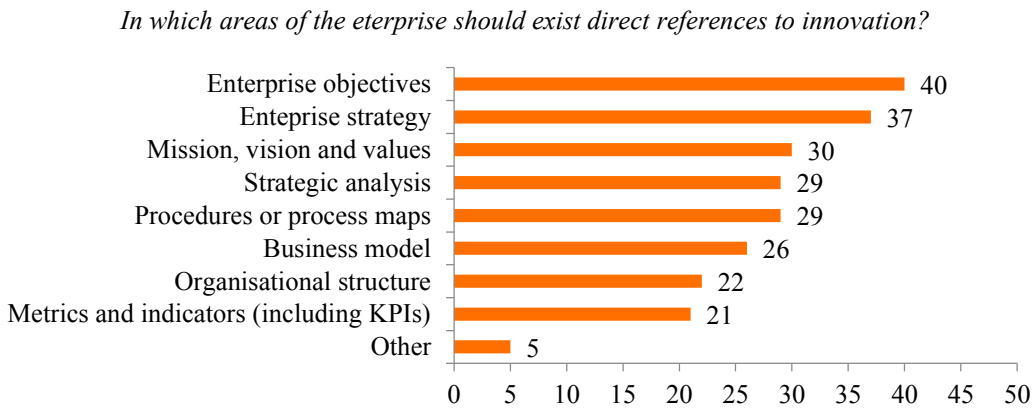

Figure 3. Areas that should exist the direct references to innovation.

Source: own elaboration.

One of the most important issues examined in the study concerned the types of innovations implemented by the enterprises. These innovations constitute both key instruments of innovation strategies and business models as well as tangible outcomes (effects) of their implementation, particularly important for enterprise's competitiveness and development. The type, scale, and structure of innovations reflect the enterprise's preferences and innovation implementation-related needs, which results from competitive position, development policy, financial and organizational capabilities, as well as the organization's knowledge resources (intellectual potential of innovations). Figure 4 presents responses to the question concerning the types of innovations implemented by the enterprises over the past three years. The data indicate the dominance of two types of innovations, i.e. product innovations (80% of enterprises) and process innovations (66% of enterprises). Such a strong position of innovations results from the SMEs' need for differentiation strategies, particularly through the production of materials and products characterized by unique and atypical features. Examples include composites, custom castings, and monocrystals. Such products meet specific customer requirements and are frequently used as inputs in further processing stages, frequently generating advanced products. The need to implement product innovations is also affected by the requirements imposed by large corporations within cooperative supply chain systems,

for example in the automotive industry. The significant role of the implementation of process innovations is linked to the technical and product-specific characteristics of the metallic and non-metallic materials production sector, to which the surveyed business organizations belong. Frequently, the development of novel products depends on the implementation of process innovation, usually in the form of new technologies. Process innovations can contribute to reductions in the consumption of energy, materials and labor input, thereby significantly lowering direct production costs, which, in turn, enhances cost competitiveness and increases the first-level contribution margin. Interest in process innovations may also result from the requirements and principles of sustainable economy, including environmental conditions and circular economy. An example is so-called "green steel," which is increasingly preferred by investors within the EU and produced using environmentally friendly technologies.

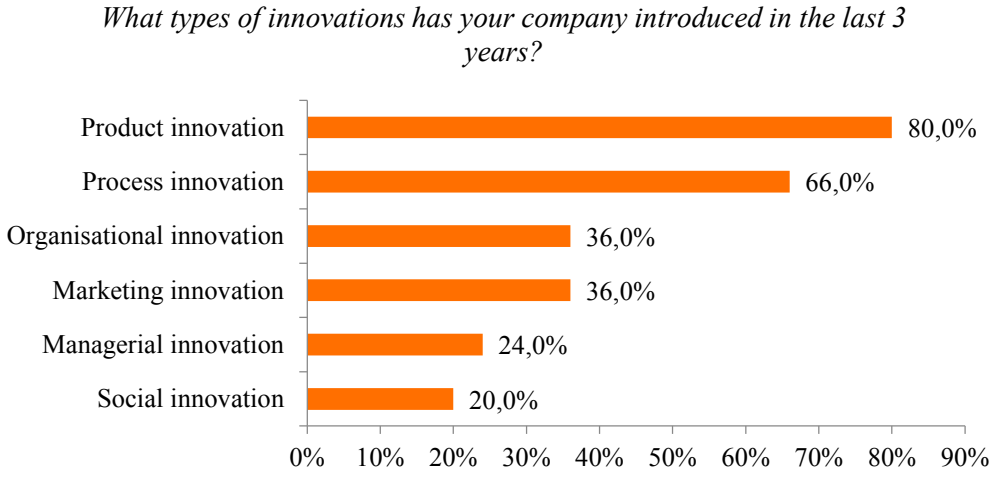

Figure 4. Types of innovations introduced by companies in the material production and processing sector - more than one indication possible.

Source: own elaboration.

As shown in Figure 4, an equal percentage of surveyed enterprises (36%) declare implementing marketing and organizational innovations, while 24% report the implementation of managerial innovations. In view of the fact the surveyed enterprises operate in an open and highly competitive market, the achieved level of implementation of strongly market-, customer- and management-related innovations, may be considered relatively low. A moderately positive finding, however, is the fact that one in five enterprises reports implementing social innovations. This situation indicates a growing interest in the innovation potential within this area, as well as in the possibilities of supporting such innovations, which are gaining increasing importance in the context of sustainable economy development.

The issue of innovation measurement was presented in the context of two aspects, i.e. in relation to the current state and the postulated state. In the first case, the question was connected with innovation-related indicators or measures used in enterprises. The distribution of responses to this question is presented in Figure 5. An analysis of the responses reveals the

relatively rare use of measurement systems for implemented innovations and their outcomes among the surveyed enterprises.

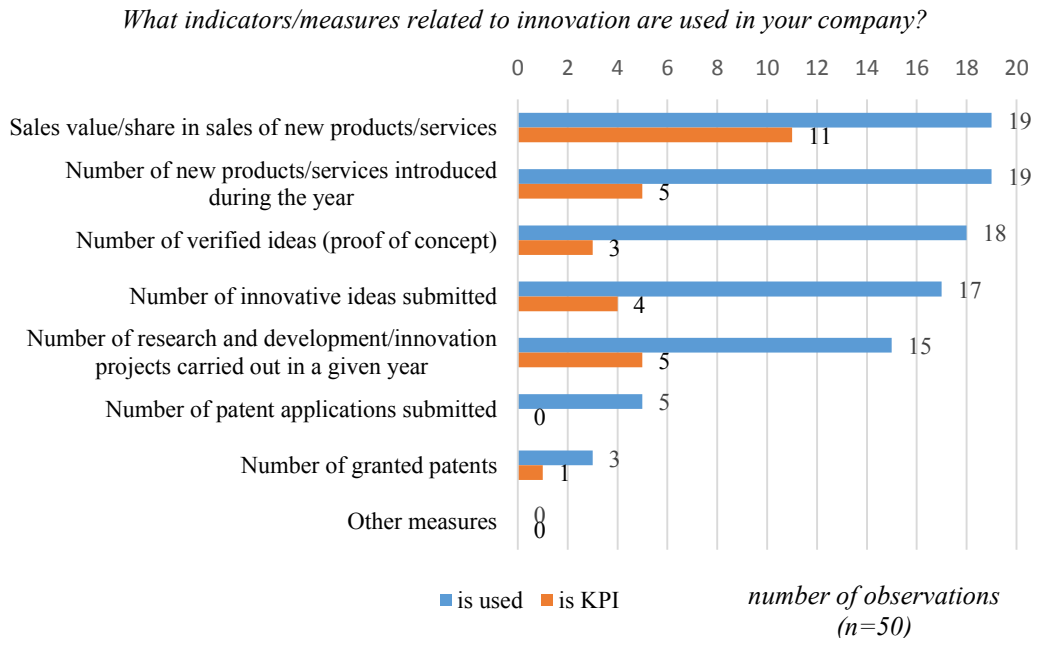

Figure 5. Innovation-related metrics and indicators used in enterprises.

Source: own elaboration.

Among the firms measuring the results of implemented innovations, preferences are related to the following indicators:

- sales value and/or the share of new products in sales, used by 19 enterprises, of which 11 consider it a key indicator of the effectiveness of implemented innovations,
- number of new products (services) introduced within a year, used by 19 enterprises, of which 5 regard it as a key indicator of the effectiveness of implemented innovations.

The use of these indicators corresponds with the significant importance attributed to product innovations in the enterprise operations. In turn, more than 35% of the enterprises associate innovativeness with the number of verified (implemented) ideas, while slightly fewer with the number of submitted ideas. Relatively many enterprises (15) use the number of completed research and innovation projects as a measure of innovativeness. This suggests that such projects are perceived as important, despite the fact the enterprises declare a relatively low percentage of turnover allocated to such activities. The use of the BSC operational instrument (i.e., KPIs) for measuring innovation outcomes remains very limited. Slightly more than one-fifth of the surveyed enterprises apply KPIs with reference to relationships between the results of product innovations and the volume of sales. In terms of the remaining innovation outcome indicators, the use of KPIs does not exceed 10%. Figure 6 presents the distribution of responses to the question concerning innovation-related indicators/measures which should be applied within the surveyed enterprises.

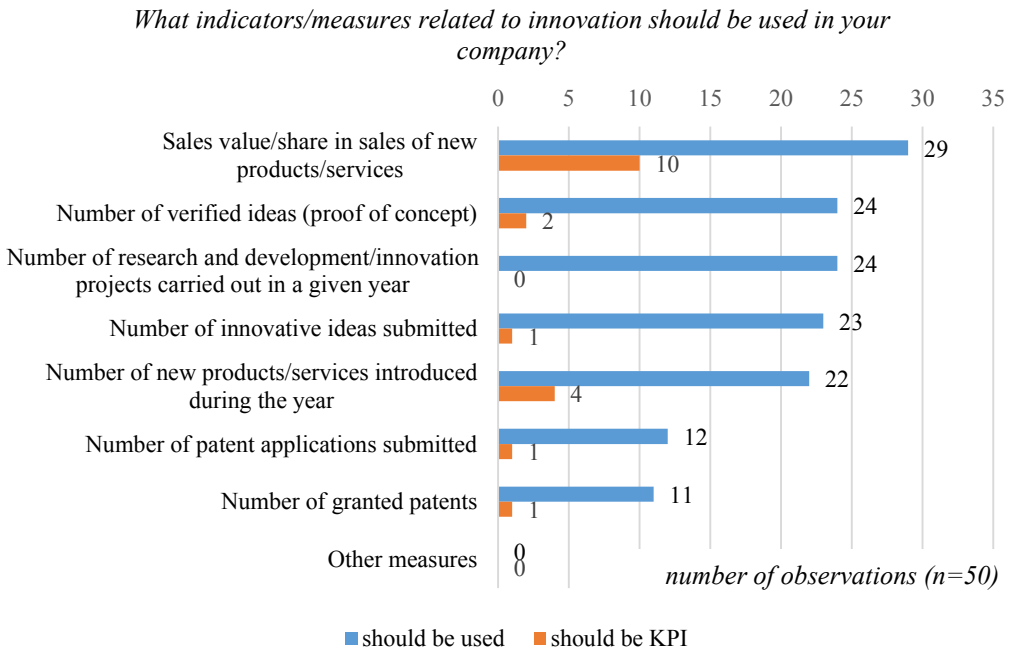

Figure 6. Innovation-related metrics and indicators that should be used in enterprises - respondents' opinion.

Source: own elaboration.

In this case, significantly more enterprises support the use of indicators characterizing implementation of innovations. The largest number, i.e., 58% of the enterprises (29) support the use of the sales value or share of new products in total sales as the innovation implementation-related indicator. Nearly half of the surveyed enterprises believe that the above-mentioned measure should be based on the number of verified (implemented) ideas, the number of completed research and innovation projects, as well as the number of submitted innovative ideas. Similarly to the previous question, the interest in using the BSC operational instrument (i.e. KPIs) remains very limited, and in some cases negligible.

A key research issue is the impact of innovation on the business model, hence the question: "Which elements of the business model have been affected by innovations implemented over the past five years?" The answers to this question are presented in Figure 7. The impact of innovation on the value created for the customer is by far the highest-rated. As many as 86% of the surveyed entities recognize this relationship. This confirms many theoretical considerations regarding business models in particular, the factors that shape their value to the customer. This assessment reflects an awareness of the role of innovation in achieving competitive advantages, which are largely determined by the value created for the customer—enabling their needs to be met or their problems to be solved, and even fostering prosumer relationships, i.e. an exchange of value with the customer. According to the respondents, innovation has a significant impact on a company's tangible assets; 76% of respondents agree with this. This correlation can be explained by the nature of the sector represented by the organisations under analysis; these are predominantly manufacturing enterprises where modernisation

through the introduction of innovations to tangible assets such as machinery, equipment and logistics resources determines the competitiveness and operational efficiency of these enterprises, and often their compliance with environmental requirements or, more broadly, sustainable development.

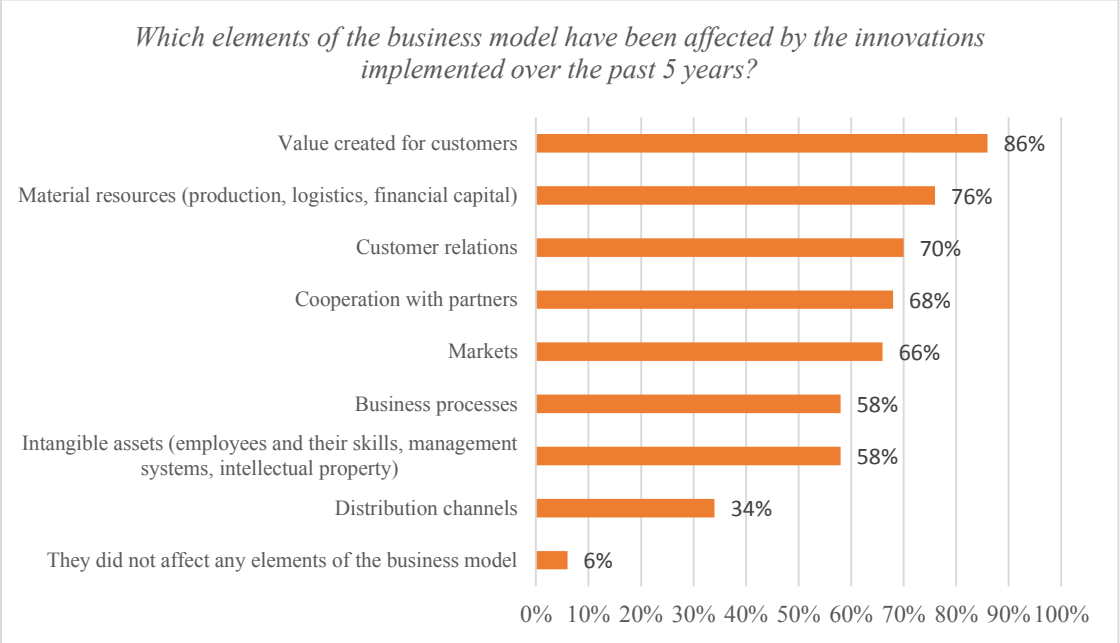

Figure 7 Elements of the business model affected by innovation.

Source: own elaboration.

According to the respondents, innovation had a lesser impact (58.0%) on intangible resources than on tangible resources, although this result should be considered fairly satisfactory (the majority). The same result was obtained when assessing the impact of innovation on another important element of the business model, namely business processes. Comparing this with the extent of the impact of innovation on tangible assets, it can be concluded that companies modernise business processes more often than they introduce new ones. The impact of innovation on distribution channels is rated relatively poorly (34% of companies), which is linked to the nature of the enterprises and their position in the supply chain. Most of these are manufacturers of metals, plastics and ceramic materials using 'traditional' logistics processes to supply their products to customers who process them. On the other hand, the impact of innovation on partnerships was rated very highly, with as many as 68% of the surveyed companies agreeing with this. This is a beneficial phenomenon in terms of creating market advantages (coopetition) arising from opportunities for cooperation. The impact of innovation on customer relations was also rated very highly (70% of respondents), which indicates an appropriate product offering that delivers value and the introduction of marketing innovations (e.g. CRM). A large number of companies report that innovation has an impact on the markets they serve, which is linked to the use of product and marketing innovations. Only 6% of the surveyed entities believe that innovation has not affected

the structure of their business model. This means that these companies are able to apply innovations and create a competitive advantage within their existing business model. In turn, the answers to the question "Which elements of the strategy have been affected by the innovations implemented over the last 5 years" refer to the dynamics of the strategy in terms of the innovations applied, and the structure is shown in Figure 7. In the overall projection of the strategy's elements we can conclude that the impact of the innovations introduced on their operations is significant, although not as widespread as in the case of business models.

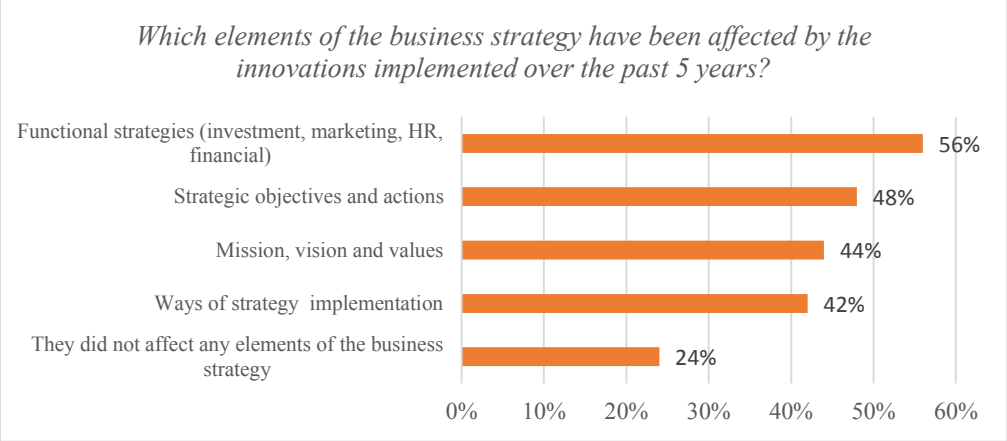

Figure 8 Elements of the business strategy affected by innovation.

Source: own elaboration.

Almost half of the respondents recognise the impact of innovation on strategic changes within their organisations. Innovation influences changes to fundamental elements of strategy, such as strategic objectives and the organisation's mission and vision. The impact of innovation on strategic objectives and actions is reported by 48% of respondents, which indicates that innovation is being used to formulate new objectives and directions for action, as well as for the strategic reorientation of companies. As many as 44% of respondents recognise the impact of innovation on changes to the mission and vision. These core elements of strategy often have a lasting, long-term and almost imperative nature; they are regarded as the foundation upon which strategic objectives and initiatives are defined, which is why the survey results can be considered rather unexpected. Innovation has a fairly significant impact on strategy implementation, according to 42% of respondents, which points to the significant role of process innovation in the organisations surveyed. The impact of innovation on changes in functional strategies is rated most highly among the surveyed companies, with 56% of respondents stating this. The need to utilise innovation in functional strategies stems from their nature, namely a certain degree of flexibility and the necessity to respond swiftly to changes in the environment. Innovation can serve as an important instrument for implementing changes in investment, marketing or financial strategies aimed at enhancing the company's competitiveness and efficiency. One in four (24%) of the surveyed entities assess that innovation has no impact on changes in strategy, which means that in these companies, innovation does not constitute a significant long-term factor for development.

The present study can be compared to the work of Safin (2016). Similarities can be observed in the subject matter of the research, which focused on the business models of innovative enterprises in one of Poland's regions (Lower Silesia). The aim of the study was to identify these models, their components, and the relationships between them. Based on the findings of this study, derived from interviews with enterprise management, it is worth emphasizing the significant impact of innovation on business models (as confirmed by our research) and on their structural elements, as well as the necessity of dynamic changes in business models. The author emphasizes the need for further in-depth research on the business models of innovative enterprises, which corresponds to the subject matter of this paper. With regard to the use of KPIs for implementing innovation strategies, the results obtained can be compared with those of Sawang (2011), who conducted his research on a sample of 86 companies in Thailand. He demonstrated, above all, the importance of innovation outcome indicators such as sales and sales growth, as well as indicators characterizing the production process.

5. Case studies

An important component of the empirical study was an in-depth analysis of innovation management in relation to strategy and business model in four selected enterprises (case studies). Table 1 presents the key elements, resulting from the case study, for one of the selected enterprises, referred to as Firm A. In terms of employment and sales revenues, the company qualifies as a medium-sized enterprise. It is a family-owned limited liability company that has been operating for 25 years. The enterprise is active in the sector connected with the production of materials used for marking and automatic product identification across various industries. The firm has used and continues to use EU funds for its development, including digitalization, robotization, and social innovation-related processes. In recent years, the enterprise's annual profit has remained at approximately PLN 30 million, while the values of investments over its 25-year history has reached around PLN 100 million. Over the past 10 years, Firm A has invested nearly PLN 15 million in research and development activities. The enterprise is also strongly engaged in social initiatives within the local community, supporting healthcare and social welfare programs. The MIOD-based evaluation of the innovation management presented in Figure 7 confirms the importance of this process.

Table 1.
Elements and characteristics of Company A's innovative strategy and business model

Elements and characteristics of an innovative strategy and business model	
Basic strategy	A clearly defined strategy (mission, vision, values, strategic goals) known to employees and stakeholders. A strategy based on innovation: product, process, marketing, organisational and social. The company applies the principles and standards of sustainable development (ESG). Increase in the value of the company through the creation of economic profit (EVA), investments in innovation, and research and development.
Products	Films and textiles, sew-in labels and multicoloured paper labels, electrical safety devices, materials for special applications, advanced multi-layer components, special labels, insulators, thermal pads, tapes, small components for electronics, automotive, automation, aviation and defence industries. A wide range of products, a high level of product innovation, flexible adaptation to customer needs.
Markets and customers	The Company's products are used in manufacturing sectors (household appliances, automotive, consumer electronics, machinery and equipment, visual advertising). The Company's customers include global leaders in these sectors. Well-mastered CRM and flexible market behaviour.
Applied innovations	The company utilises virtually all types of innovation, including social innovation. Product and process innovation are of utmost importance for creating competitive advantage. Thanks to its developing R&D zone, the company applies both external and internal innovation.
Competitive advantage	Although self-adhesive labels have historically been the core of production, the company's competitive advantage lies in its ability to create competitive products that meet the standards and expectations of demanding foreign customers. These are specialised, innovative information, protective and security products.
Customer value generated by the business model	The vast majority of the value is created by innovative, novel, high-quality products. They provide the customer's end products with the following functions: informational, advertising, sealing, securing, insulating, protective, decorative, connecting (adhesive) and warning.
Social architecture of the business model	The pillar of social architecture is highly qualified employees who use digital, telecommunications and IT tools in automated business processes. The Company uses a decentralised management system characteristic of a so-called teal organisation based on autonomy, trust and minimal formalisation. Employee innovation and research and development are also important. The benefits system and employee integration strengthen the motivation system.
Technical architecture and business processes	Modern industrial infrastructure, production and logistics equipment financed from own and EU funds. Continuous process of introducing product and process innovations. Digital Economy tools and automation are used in over 50 short production sequences (business processes).

Source: own study.

It is noteworthy that a high level of agreement was observed between the expert assessment and the enterprise's self-assessment. Consistency was found in seven out of nine cases as regards the factors subjected to evaluation. In summary, the analysed enterprise employs a variety of innovations to implement an innovation-driven sustainable development strategy and an Industry 4.0-oriented business model.

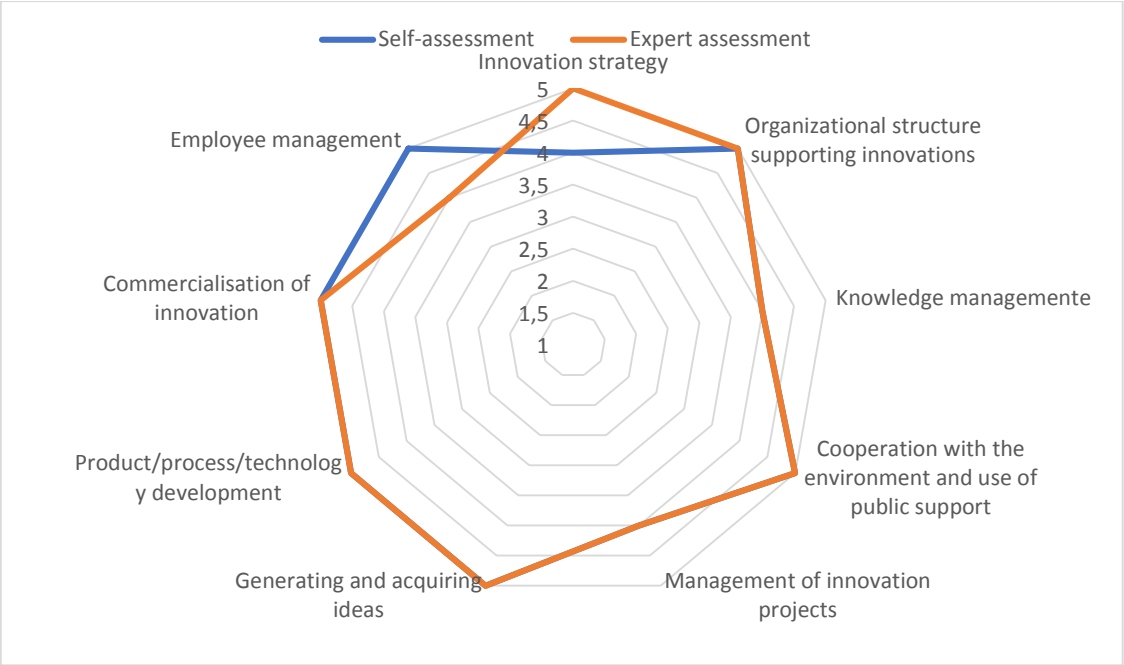

Figure 9. Assessment of company A according to the MIOD method.

Source: own elaboration.

6. Conclusion

The metallic and non-metallic materials production and processing sector continues to represent an important branch of industry in Poland, supplying products to numerous areas of the economy. The development of industries such as defense, automotive, renewable energy, and construction is driving growing demand for increasingly advanced materials. At the same time, Polish enterprises face significant competition, particularly from East Asian countries, making increased innovativeness a necessary condition for operating successfully in an open market. In this context, research in the field of innovation management remains both relevant and justified. The study findings indicate that enterprises very frequently implement product and process innovations. To a lesser extent, this applies to marketing and organizational innovations, which is an unfavorable phenomenon in the context of an open and highly competitive market. A relatively positive situation is the use of social innovations, which indicates that enterprises are increasingly oriented toward sustainable development. The limited share of internal financing allocated to R&D&I activities indicates the need for broader external funding support. Most enterprises recognize strong links between innovations and strategy (with its fundamental elements), whereas the relationship between innovations and business models is recognized by fewer firms. Limited attention is devoted to value management using the BSC instrument. In practice, the operational tool of the Balanced Scorecard, i.e. namely KPIs, is very rarely applied to measure the outcomes of implemented innovations. The scope

of the survey study conducted within the Project enabled the acquisition of knowledge concerning innovations in the materials production and processing sector, thereby providing a significant informational contribution to the Regional Knowledge Management Model. The information and opinions obtained within the Project constitute a component of information resources enabling the development of instruments supporting the management of innovations and reducing the risk associated with their implementation.

The most significant research limitations stem from the nature of the study, in which the sample was restricted to enterprises in a single region (the Silesian Voivodeship) and a single sector (materials production and processing). Nevertheless, the study's findings hold considerable practical and cognitive significance given the importance of the manufacturing industry to the economy. Further regional research will delve deeper into the specific conditions of business models and new challenges related to the implementation of innovations in the materials production and processing sector.

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