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IMPROVING STRATEGIC MANAGEMENT IN THE FOUNDRY INDUSTRY USING KPI

Karolina CZERWIŃSKA[1], Andrzej PACANA[2*], Agata GIERCZAK[3]

[1] Rzeszow University of Technology, Faculty of Mechanical Engineering and Aeronautics, k.czerwinska@prz.edu.pl, ORCID: 000-0003-2150-0963
[2] Rzeszow University of Technology, Faculty of Mechanical Engineering and Aeronautics, app@prz.edu.pl, ORCID: 0000-0003-1121-6352
[3] Rzeszow University of Technology, Faculty of Management, agatag@prz.edu.pl, ORCID: 0000-0002-8402-0919
* Correspondence author

Purpose: The goal was to develop a universal set of key performance indicators (KPIs) for evaluating production activities carried out at metals companies as part of a growth strategy.
Design/methodology/approach: An analysis of the literature on the subject was performed, and interviews and observations were conducted at foundry companies located in southeastern Poland.
Findings: Key objectives of the development strategies of foundry companies were identified in relation to which a set of KPIs was proposed to evaluate production activities. Within the framework of strategic development, the following key areas were highlighted: optimizing energy and water consumption, increasing customer satisfaction, increasing production flexibility, increasing productivity, and reducing waste and related costs.
Research limitations/implications: Future research directions will include the development of a universal set of KPIs for other key areas of foundry companies and the development of software that will allow monitoring and control of the indicators in real time.
Practical implications: The developed set can be successfully implemented in foundry companies that plan to imply a strategic scorecard, which is a tool for advanced strategic analysis, as part of management improvement. The proposed set of KPIs provides an excellent foundation for the construction of a strategic charter in foundries as part of the concern to raise their level of competitiveness.
Originality/value: Filling the research gap on how to conduct effective monitoring, control and analysis of the implementation of the objectives of key development strategies (production area) of foundry enterprises through the use of KPIs. The study and the proposed set of KPIs is addressed to the management of business entities.
Keywords: Mechanical engineering, management and quality, foundry industry, metal industry, Key Performance Indicators (KPI's).
Category of the paper: Research paper.

1. Introduction

A changing environment, dynamic globalization, increasing intensity of competition and the threat of crisis phenomena determine the creation, implementation, monitoring and improvement of innovative management systems. Maintaining a relatively stable competitive advantage means for enterprises to orient the production and management space to increase efficiency and innovation. Economic activity involves the creation of value that satisfies specific requirements and needs, or brings various benefits to the producers and stakeholders involved (Klimecka-Tatar et al., 2021; Ulewicz, Novy, 2019). For manufacturing companies, this value is a tangible product or, less frequently, a service, which shares many similarities related to value creation, meeting specific needs and generating benefits. However, it is distinguished by the conditions under which they are produced, offered or consumed. These conditions influence most design and production processes (Pietraszek et al., 2020; Gajdzik et al. 2022).

The development of foundry enterprises is determined mainly by the skillful use of emerging development opportunities and the search for innovative solutions, both technological, production and in the organizational and management areas (Luczak, Wolniak, 2016; Gawlik, 2016). Changes in the global economy and the situation in the local market, not infrequently indicate the direction of development of manufacturing enterprises. This is related to making developmental and improvement decisions at various levels of management, including the most important decisions - strategic ones (Pacana et al., 2024). The growing influence of end customers on the decisions made by companies has also contributed to the fact that in sectors related to metal processing, i.e. the manufacture of consumer items, the implementation of processes according to the achievement of key objectives (often in line with sustainable development) and their monitoring is gaining importance (Ksiazek, Ligarski, 2016). Manufacturers operating in the metalworking industry are constantly faced with numerous challenges related to ensuring adequate product quality and reducing adverse environmental impacts. These are the result of increasing customer demands and pressure to continuously improve business and environmental performance (Klimecka-Tatar, Ingaldi, 2020).

Among some of the most important management tools in organizations are key performance indicators (KPIs) (Tu et al., 2010; Pacana, Czerwinska, 2021). A key performance indicator in a manufacturing company is a carrier of information (often as an indicator, absolute measure or process statistic) for quantifying and communicating achievements (especially: efficiency, effectiveness, quality, performance, financial health) and identifying and indicating priority processes, activities and values that motivate effective strategy implementation (Parmenter, 2016; Czerwińska et al., 2020). These indicators make it possible to reduce complex information about the company and its performance to a small number of key data, providing

understandable results on the basis of which conclusions can be drawn and the course of action can be modified (Hollender, 2016; Czerwinska, Pacana, 2020). In this context, it becomes reasonable to define goals in the production space of metallurgical enterprises and, on this basis, develop a set of adequate key performance indicators.

The goal was to develop a universal set of key performance indicators (KPIs) for evaluating production activities implemented in metal industry companies as part of their development strategy. The proposed solution will increase the efficiency of implementation of strategic objectives and improve the control of strategy implementation and monitoring of environmental impact. Implication of the proposed model will allow identification of areas for improvement in the context of conducting so-called green production.

2. Foundry industry

The foundry industry is part of the metallurgical industry that produces metal products. Various plastics are used in the production of products (castings), which differ in chemical composition and physical properties, which determines the possibilities of their use. Casting plastics include: cast steel, cast iron (gray, ductile, malleable), as well as light metals (aluminum, lead, copper and zinc) (Malinowski, 2021; Gajdzik, 2013).

The customers of the foundry industry are many branches of production, which can be grouped as follows: the automotive industry, mechanical engineering and manufacturers of industrial fittings (e.g., municipal and sanitary appliances, household appliances, building structures, tools). Cast products are an intermediate link (components) of many chains, within which they serve as a subordinate link, which determines the need to accept standards and requirements set by the chain leaders (Grzybowska, Gajdzik, 2014). The significant level of customer diversity contributes to the foundry's dependence on demand for end products, with none of these customers being able to produce end products without the component parts - castings. This positioning lends great importance to this industry for the economy. An analysis of the current state of the global economy and development trends indicates an increasing increase in the share of foundry (a technique for processing and manufacturing metal products) (Bris et al., 2021; Pacana, Czerwinska, 2023a).

Suppliers to the foundry industry are: suppliers of scrap, foundry pig iron, coke, as well as other materials and technical solutions. The ties between foundry companies and their suppliers vary and depend on: the number of suppliers, the specifics of the supply market, the form of the supplier-customer relationship, and the pricing policy adopted (Miskinis, 2021).

The indicated features such as the diversity of technologies and materials used, products manufactured, target markets of customers, project the specificity and considerable heterogeneity of the foundry industry (Khan et al., 2023). This is revealed in the dominance of

cast products in a relatively narrow group of manufacturers, as well as the specificity of competition (competitiveness within such following strategic groups: large batch casting for the automotive industry, die casting of small castings in large batches, flexible foundries with a predominance of small and medium castings and large casting) (Ulewicz et al., 2023; Uyan, et al., 2023). The characteristics presented above influence the formation of the economic reality of foundry companies, which is also influenced by the fact that the foundry industry, despite tremendous modernization, is still perceived as a "dirty industry," which creates very difficult working conditions and which uses outdated technologies with negative environmental impact, which contributes to its low attractiveness (Kolmasiak, 2024; Shi et al., 2021). In addition, the foundry industry continues to be characterized by lower economic indicators (e.g., labor productivity and capital intensity of production) compared to those achieved in other industries. In addition, the foundry industry continues to be characterized by lower economic indicators (such as labor productivity and capital intensity of production) compared to those achieved in other industries (Sordan et al., 2024). The specifics of the industry outlined above require and generate the need to monitor and control the degree of implementation of key provisions of the strategy in foundry companies. In addition, there is considerable pressure to implement solutions to measure the degree of implementation of important strategic objectives and lead to the realization of provisions of sustainable development.

3. The essence and place of KPIs in strategic management

The decision-making process in manufacturing companies should be based on sound knowledge and analysis and on developed standards. However, it happens that reliance on business intuition is forced by the need to take quick action. Failure to manage by facts is a big mistake that results in a decrease in the efficiency of implemented activities and a greater risk of making costly mistakes (Wolniak, Grebski, 2018; Czerwińska, Pacana, 2022).

In order to improve the decision-making process in the enterprise, it is necessary to standardize the process, which will allow for the seamless use of necessary and verified information. It is essential to gather reliable data, or facts, at the very source (Ingaldi, Dziuba, 2020). They should then be analyzed, remembering to take into account the associated context. To this end, a system of KPIs adequate to the needs of the enterprise should be introduced, and constant monitoring and control should be carried out (Grycuk, 2010; Pacana, Czerwińska, 2023). A diagram of the essence of KPI implementation is shown in Figure 1.

Based on the information extracted from the data, knowledge is obtained, which allows to efficiently make a repeatable and right decision regardless of who has to make it and in what situation.

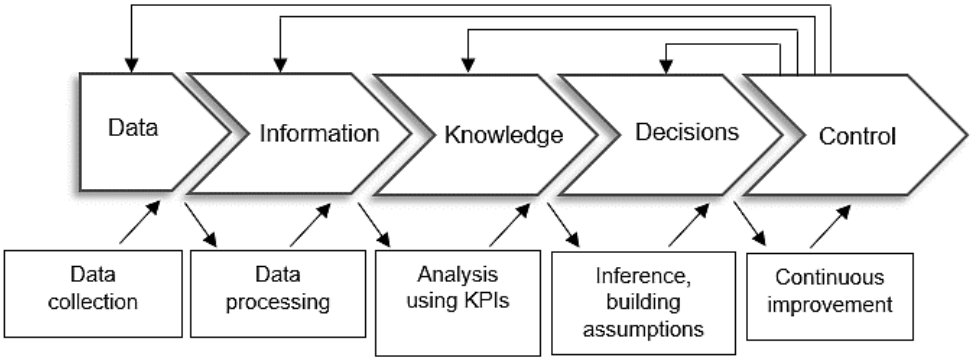

Figure 1. Implementation of KPIs in a manufacturing company with consideration of effective strategic decision-making.

A skillfully designed system of indicators is the basis for a well-functioning decision-making process that increases the likelihood of choosing the right solution for a given situation. It is very important that KPIs are defined in a way that makes it possible to understand how strategic goals are achieved (Beneliene, 2021; Czerwińska, Pacana, 2020a).

4. Linking KPI to the goals of foundry industry companies

Analysis of the literature on the subject, conducted research, interviews and observations in foundry companies located in the southeastern part of Poland made it possible to identify the key objectives of development strategies. The identified objectives were closely related to the main pillars of the strategy (Contini, Peruzzini, 2022; Malinowski, 2021; Shi et al., 2021; Chen et al., 2021; Pacana et al., 2022; Hajduk-Stelmachowicz, 2014, 2018, Hys, Hawrysz, 2012). The selected main objectives were:

- optimization of energy and water consumption,
- increase in customer satisfaction,
- increasing production flexibility,
- increasing productivity,
- reducing waste and associated costs.

The indicated goals should be monitored and subject to constant review. Regular monitoring of the progress in achieving the goals allows rapid identification of problems and making necessary adjustments, which is crucial in a dynamically changing market environment. Therefore, it was proposed to apply key performance indicators to manage the main aspects of the development strategies of foundry companies. A set of indicators for the identified areas was designed, which supports the supervision of the main aspects of strategy implementation, which will ultimately enable the enterprise to achieve global optimization and success. The set of indicators is presented in Table 1.

Table 1.
A set of KPIs relevant to the main pillars of the development strategy of foundry companies

Area	Key objective	KPI	Frequency use
Optimization of energy and water consumption	Reduce the level of energy and water consumption in the production space (improvements)	• Electricity consumption per unit of product (KPI_1), • Gas consumption per unit of product (KPI_2), • Fuel consumption per unit of product (KPI_3), • Water consumption per unit of product (KPI_4),	Once/month
	Reduce the level of energy and water consumption of labor resources (investments)	• Level of spending on energy-efficient machinery per unit of time (KPI_5), • Level of spending on energy-saving measures (improvements) per unit of time (KPI_6),	Per year
Increase in customer satisfaction	Reduction of non-compliance with customer requirements	• Percentage of quality-compliant products manufactured (KPI_7), • Percentage of inspected products after the casting process (KPI_8), • Percentage of inspected products after the pretreatment process (KPI_9), • Percentage of inspected products after the finishing process (KPI_{10}), • Percentage of finished products inspected (KPI_{11}),	Once/week/month
	Reduce lead time	• Percentage of time to prepare an order for production (KPI_{12}), • Percentage of finished product lead time (KPI_{13}),	Once/week/month
	Reliable lead time	• Percentage of orders with consistent planned and actual lead times (KPI_{14}), • Percentage of orders with delayed lead time (KPI_{15}), • Magnitude of delayed order fulfillment (KPI_{16}),	Once/week/month
	A reliable estimate of the cost of the contract	• Percentage of orders with the same planned and actual cost (KPI_{17}), • Percentage of orders with less actual cost than planned (KPI_{18}), • Percentage of orders with higher actual cost than planned (KPI_{19}),	Once/week/month
	Reduce response time to customer inquiries	• Lead Time Planning (KPI_{20}),	Once/week/month
Increase in manufacturing flexibility	Increase in the level of flexibility of employees	• Percentage of employees able to operate more than one workstation (KPI_{21}),	Once/month
	Increase in the level of flexibility of production lines	• Percentage of production lines able to change their production profile, (KPI_{22}),	Once/month

Cont. table 1.

Increasing productivity	Increase in productivity	• Profitability of finished goods (KPI_{23}), • Value of output produced per worker in a given period (KPI_{24}), • The ratio of the quantity of a good produced to the time required to produce it (KPI_{25}), • Percentage of machine capacity to work efficiently (KPI_{26}), • Percentage of production line capacity to work efficiently (KPI_{27}),	Once/week/month
Pro-environmental costs	Reduce post-production waste and emissions and their costs	• The volume of spending solutions that reduce gas emissions in the production unit (KPI_{28}), • The volume of spending on solutions that reduce wastewater in the production unit (KPI_{29}), • The volume of spending on solutions that use and/or reduce waste in the production unit (KPI_{30}), • The amount of spending on solutions that use and/or reduce noise per unit of time (KPI_{31}).	Once/month/quarter

Source: own study.

Determination of KPIs was the initial step to build the strategic scorecard template, so they were built with reference to the goals linked to the development strategies. The indicated set of KPIs should be used for: measuring the current state, comparisons (internal and external benchmarking), performance evaluation, diagnosis (analysis of strengths and weaknesses), planning improvements, monitoring change and progress, and motivating staff. The indicated areas in some way related to each other. Emphasizing the importance of the proposed set of indicators, it can be said that KPIs are metrics whose analysis will help management staff to make decisions more easily, and technical staff to better realize the operation of equipment and infrastructure.

However, it is important to remember that indicators are not something permanent. Not only do they change their values, but they can also change form. Along with any changes in the enterprise, information needs may also change. Therefore, when defining the indicators that will best reflect the effectiveness, one should be guided by the adopted mission, vision and goals of the enterprise.

5. Conclusion

Effective and flexible management of a foundry business in a dynamically changing environment is a key factor in achieving competitive advantage. Such an approach requires identifying the main areas to be measured, monitored and controlled. The purpose of the study was to draw up a universal set of key performance indicators (KPIs) for evaluating production activities carried out in foundry enterprises. The study shows that for foundry companies, five strategic areas can be identified within the production space: optimization of energy and water consumption, increase in customer satisfaction, increase in production flexibility, increase in productivity, and green costs. These areas should be measured using KPIs.

A modern instrument for defining goals and measuring their achievement in the form of results are key performance indicators, which provide an excellent foundation for building a strategic scorecard, which is a tool for advanced strategic analysis. As part of the study, a new proprietary system based on KPIs was drawn up. The system includes 31 indicators to monitor and control strategically relevant areas within the production space. The implication of the developed set of KPIs requires a mindset based on business values delivered to customers. A skillfully designed system of indicators is the basis for a well-functioning decision-making process that increases the likelihood of selecting the right solution for a given situation.

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