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Indicator analysis of the technological position of a manufacturing company

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Abstract
A turbulent manufacturing market, especially in the metal industry, determines the quality of products and the level of production efficiency, which contributes to a company's market position and competitiveness. The aim of the study was to develop a model to define a manufacturing company's current market position using KPIs in relation to a key product - gearbox casting. The company's position was defined in terms of the relationship occurring between technological capabilities and market position. An additional aim of the study was to identify critical determinants and, ultimately, to identify conditions for strengthening market position. As a test of the proposed model, the position of the analysed company (in terms of technological capabilities and market position) was defined as "Search for occasions" - box 9 within the 3x3 matrix. Technological determinants that weaken the company's position (low level of maintenance capacity and long production cycle time) and determinants with a strong negative impact on market position (low level of human resource development) were identified. An element of novelty is the use of KPIs as variables determining the position of the company within the 3x3 matrix, which is indicative of a specific technological position in the market. Further lines of research will concern the determination of appropriate KPIs in relation to the identified critical areas of the company. Subsequent steps will concern the implications of the model in relation to the company's other key aluminium alloy castings.

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1. Introduction

Operating in a turbulent and changing environment creates high demands on companies. Management theorists and managers emphasise the importance of technology (especially high-tech in general) in building market position and competitive advantage (Murad and Thomdon, 2011; Pietraszek et al., 2020; Wolniak et al., 2017). The changes brought about by the development of technology have the effect of reducing the life cycle times of technologies and products, which has now become an everyday occurrence and even a necessity (Daryani et al., 2012; Kim and Oh, 2022; Pacana et al., 2019). Consequently, the issue of technology change and determining the appropriate moment for its implementation has become a prioritised and even strategic dilemma for technology management (Pacana and Czerwinska, 2020, Ulewicz and Mazur, 2019).

Not all technologies affect the competitive position of manufacturing companies to the same extent. Some allow building a relatively stable and sustainable advantage on the market. Some technologies are a prerequisite for competing on the market, while others play an important role in building and strengthening the advantage. In any case, it is important that the technology is commercialisable and thus not only profitable, but also adds value in the form of enhanced skills and knowledge for the company or customer satisfaction. Therefore, it is important to make a considered choice of technologies and their evaluation, which may be crucial for the company (Lyp-Wrońska et al., 2018; Pietraszek and Skrzypczak-Pietraszek, 2014; Maszke et al. 2018).

Given these considerations, it is worth noting that some of the most important management tools in automotive component manufacturing organisations include key performance indicators (KPIs) (Swarnakar et al., 2021). They are intended to facilitate the assessment of a company's performance by measuring the degree to which it is achieving the goals it has established - and this in turn facilitates decision-making, the storient prioritisation of activities and the improvement of the

company's growth strategy (Aksu et al., 2019; Werner et al., 2021). KPIs are used to measure, fundamental in economic, technical and organisational terms, the para-meters that characterise the performance of an enterprise, and they allow not only the determination of the values of the KPIs to be sto-sited (Hristov and Chirico, 2019), but also the identification of selected factors influencing their values (Di Luozzo, et al., 2022). KPIs allow, among other things: measuring the condition of facilities, tracking changes and progress in the sys-tem of operation, and continuous monitoring of organi- zational and technical changes (Manzano-Ibarra et al., 2019; Jop-pen et al., 2019).

Key performance indicators are included in EN 15341:2007 Maintenance - Maintenance Key Performance Indicators, developed by the European Committee for Standardisation (CEN), which contains a harmonised set of measures (EN 15341:2007 Maintenance - Maintenance Key Performance Indicators). The standards include the indicators that the CEN/TC Technical Committee considered to be the most important. This does not imply imposing restrictions on manufacturing companies in the area of indicator-based analyses. The literature on the subject indicates that effective KPIs should be relevant to the specific characteristics of the company, and should therefore be created and selected on the basis of individual information needs.

The aim of the study was to develop a model for defining the current position of a manufacturing company on the market using KPIs in relation to a key product - gearbox casting. The company's position was defined in terms of the relationship occurring between technological capabilities and market position. An additional aim of the study was to identify the critical determinants and, ultimately, to identify the conditions for strengthening market position.

2. Subject of study

The research was carried out at a foundry company specialising in the production of medium- and large-sized aluminium alloy castings and smaller castings with complex shapes. The company is located in Poland. The study analysed a gearbox casting used in motor vehicles (Figure 1).

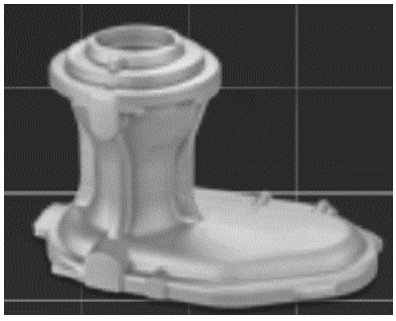

Fig. 1. Test object - illustrative gearbox model

The gearbox is a mechanism that allows the engine to adapt to varying operating conditions by changing the transmission ratio. That is, the efficient use of the power generated by the engine through combustion of the fuel-air mixture. In other words, the gearbox makes it possible to achieve the optimum engine speed in accordance with the current load and driving speed. In modern vehicles, gearboxes must meet a number of requirements. Among the most important are the reliability and service life of the gearbox (Barbieri et al., 2019; Liao et al., 2018; Makarova et al., 2021).

The product is cast from an aluminium alloy from the sub-eutectic silumin group - AlSi7Mg0.3 (EN AC-42200). The chemical composition and mechanical properties of the alloy used are shown in Table 1.

Table 1. AlSi7Mg0.3 alloy specificity

Chemical composition		
Element	Min	Max
Fe	-	0.19
Si	6.50	7.50
Mn	-	0.1
Ti	-	0.25
Cu	-	0.05
Mg	0.45	0.70
Zn	-	0.07
Others	each: 0.03; total: 0.01	
Al	remainder	

Mechanical properties			
Property name	Min [%]	Max [%]	Unit of measure
Tensile strength (Rm)	300	350	N/mm^2
Yield strength ($R_{0.2}$)	320 240	280	Mpa N/mm^2 MPa
	240		
Elongation at break (A)	4	6	%
	6		%
Brinell hardness	100 151	151	HB HB

Source: Own elaboration based on (PN-EN 1706:2011. Aluminum and aluminum alloys Castings. Chemical composition and mechanical properties, 2011, Warsaw: PKN)

The AlSi7Mg0.3 alloy is characterised by very good welding and machining properties, as well as significant corrosion resistance (Hren et al., 2019) and relatively good mechanical properties (Siegfanz et al., 2013), making it used for casting products with complex shapes, for example engine parts (Zimmermann and Sturz, 2007).

3. Research methodology

The matrix used in the study is the 3x3 matrix, which was originally presented in (Lowe, 1999) and its modifications can be seen in (Borkowski et al., 2012; Klimecka-Tatar and Ingaldi, 2020; Ingaldi, 2014). The matrix indicates correlations between technological capabilities - X-axis and market position - Y-axis. In the original version, factors located in relation to the X-axis and Y-axis, respectively, are assessed, while in the study, the indicators proposed for the company relating to technological capabilities and market position are analysed.

The area of the matrix is divided into 9 fields, which testify to a specific technological position of the company in the context of manufacturing the analysed product. The goal of each enterprise should be to achieve field number 1 - "Focus on the revealed opportunity" (Figure 2). Within this field, both studied variables score high, which indicates a high technological capability and a very good position in the market (competitiveness) (Borkowski et al, 2014).

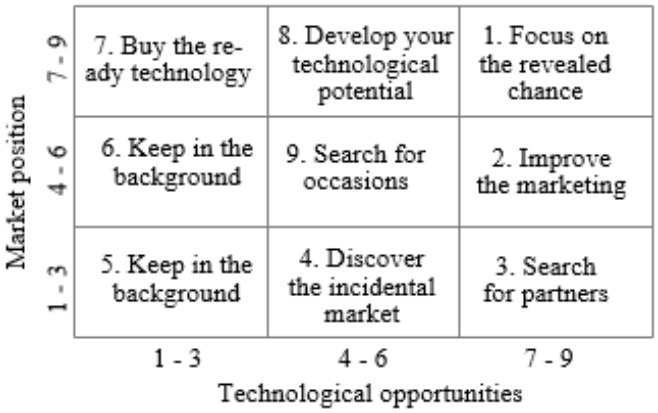

Fig. 2. A general treatment of the 3x3 matrix

The results from the indicators were evaluated on a 9-point scale, where successive scores indicated 1-3 weak, 4-6 medium, 7-9 strong impact on technological capabilities and market position. The indications of the highlighted KPIs were rated on a 9-point scale according to the expected indications of the individual KPIs. These were based on the company's capabilities and goals (Table 2).

The assessment can support the process of creating a company's development strategy by identifying the critical determinants and ultimately the conditions for strengthening market position.

The first step of the study proposes key performance indicators that will most closely reflect the technological capabilities and market position of the company. The analysis does not include factors that do not qualify for the indicated areas. The indications of the KPIs were then evaluated.

The next step of the procedure consisted of calculating the average value of the two examined areas. The values obtained were plotted on a 3x3 matrix in order to define the technological position that the company's gearbox production allows it to achieve.

The product under analysis, due to the complexity of its technological process, allows the introduction of a much broader view of a company's technological potential. This potential will include, inter alia, technologies (general and specific), research and development activities, their effectiveness and efficiency, the creativity and entrepreneurship of employees, their key capabilities, competencies, as well as their willingness to learn and change technologically.

Table 2. Expectations for selected KPIs

No.	KPIs indicative of technological capabilities Featured KPIs and rating scale		
1.	OEE		
	50%-69% - 1-3;	70%-89% - 4-6;	90%-100% - 7-9
2.	Maintenance capacity		
	<63% - 1-3;	64%-84% - 4-6;	85%-100% - 7-9
3.	Quality		
	71%-80% - 1-3;	81%-90% - 4-6;	91%-100% - 7-9
4.	Cost		
	<78% - 1-3;	79%-89% - 4-6;	90%-100% - 7-9
5.	Lead time		
	71%-80% - 1-3;	81%-90% - 4-6;	91%-100% - 7-9
6.	Level of resource utilisation		
	71%-80% - 1-3;	81%-90% - 4-6;	91%-100% - 7-9
7.	Cycle time		
	<63% - 1-3;	64%-84% - 4-6;	85%-100% - 7-9
8.	Flexibility		
	<63% - 1-3;	64%-84% - 4-6;	85%-100% - 7-9
9.	Automation		
	<39% - 1-3;	40%-69% - 4-6;	70%-100% - 7-9
10.	Compatibility		
	<63% - 1-3;	64%-84% - 4-6;	85%-100% - 7-9
	KPIs indicative of market position		
No.	Featured KPIs and rating scale		
1.	User satisfaction		
	71%-80% - 1-3;	81%-90% - 4-6;	91%-100% - 7-9
2.	Business efficiency		
	<63% - 1-3;	64%-84% - 4-6;	85%-100% - 7-9
3.	Development of human resources in the area		
	<63% - 1-3;	64%-84% - 4-6;	85%-100% - 7-9
4.	Personal development		
	<63% - 1-3;	64%-84% - 4-6;	85%-100% - 7-9
5.	Management and organisational implications		
	50%-69% - 1-3;	70%-89% - 4-6;	90%-100% - 7-9
6.	Consumer satisfaction		
	71%-80% - 1-3;	81%-90% - 4-6;	91%-100% - 7-9
7.	Organisational learning		
	<63% - 1-3;	64%-84% - 4-6;	85%-100% - 7-9
8.	Inter-organisational cooperation		
	50%-69% - 1-3;	70%-89% - 4-6;	90%-100% - 7-9
9.	Increase in sales		
	71%-80% - 1-3;	81%-90% - 4-6;	91%-100% - 7-9
10.	Profitability of human resources		
	71%-80% - 1-3;	81%-90% - 4-6;	91%-100% - 7-9

4. Results and discussion

Listed KPIs defining the techno-logical capabilities and the foundry company's place in the market in the context of gearbox production, together with an assessment of the indicators (Table 3). The first quarter of 2022 was included in the KPI analysis. There were 10 KPIs assessing the company's technological features and 10 KPIs on the de-terminating features of the market position.

During the period under review, the average score of the KPIs determining the technological level of the company was 5.50, while that of the indicators relating to market position was 5.80. This means that the company can be assessed as average. The relationship between the analysed variables indicates that the company within the 3x3 matrix occupies the middle field - 'Search for occasions' (Figure 2).

Table 3. Evaluation of the highlighted KPIs

KPIs indicative of technological capabilities		
No.	KPIs highlighted	Evaluation
1.	OEE	7
2.	Maintenance capacity	4
3.	Quality	6
4.	Cost	5
5.	Lead time	7
6.	Level of resource utilisation	5
7.	Cycle time	4
8.	Flexibility	7
9.	Automation	5
10.	Compatibility	5
	Average value	5.50
KPIs indicative of market position		
No.	KPIs highlighted	Evaluation
1.	User satisfaction	7
2.	Business efficiency	5
3.	Development of human resources in the area	3
4.	Personal development	5
5.	Management and organisational implications	7
6.	Consumer satisfaction	7
7.	Organisational learning	5
8.	Inter-organisational cooperation	6
9.	Increase in sales	7
10.	Profitability of human resources	6
	Average value	5.80

One of the main reasons for the average technological capability rating is the company's operational and maintenance cycle structure, which is based on a strategy of waiting for failure. As a result, operational efficiency is maintained mainly through the implementation of overhaul work and thorough maintenance, which involves significant wear and tear on spare parts and frequent repair downtime. As a result, the company should improve its technological capabilities in terms of gearbox production by increasing maintenance capacity and placing more emphasis on the work of the maintenance department. This department should focus on work that increases the efficiency of the machinery fleet. The production cycle time should also be improved, especially the manual cycle time.

When analysing assessments of indicators relating to market position, the company should focus its activities on human capital, which is an essential component of the company's development, to take advantage of other pro-development factors.

It should be noted that in terms of market position, the average score reached a result close to the border of the "develop your technological potential" field. This means that technological capabilities need to be developed and improved.

The relationship of the KPI scores to the proposed nine development strategies is illustrated in the form of a lollipop chart (Figure 3).

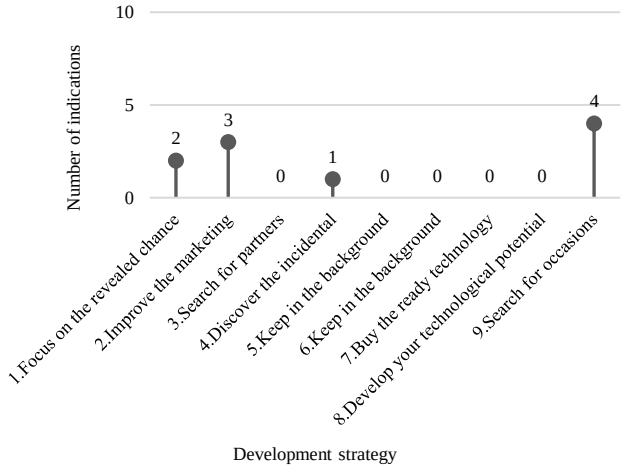

Fig. 3. Lollipop chart of the affiliation of KPI scores to proposed development strategies

Based on the characteristics of the nine areas of the 3x3 matrix (Figure 2), the analysis of Figure 3 clearly shows that the desired area number 1 contained two pairs of KPI results. The central area (number 9) was the area in which four pairs of factors were located, while areas: 3, 5, 6, 7, 8 do not contain pair ratings. This information allows the construction of a general recommendation for the establishment of a well-thought-out strategy tailored to the final audience and the implementation of the resulting action tactics based on knowledge and research, firmly embedded in the reality of the foundry market and the automotive industry (Hys, 2015; Gawlik, 2016; Miskinis, 2021).

In order to develop an adequate, detailed strategy, the next step involved analysing the distribution of assessments of key performance indicators. A map of the number of assessments against a 3x3 matrix was developed (Figure 4).

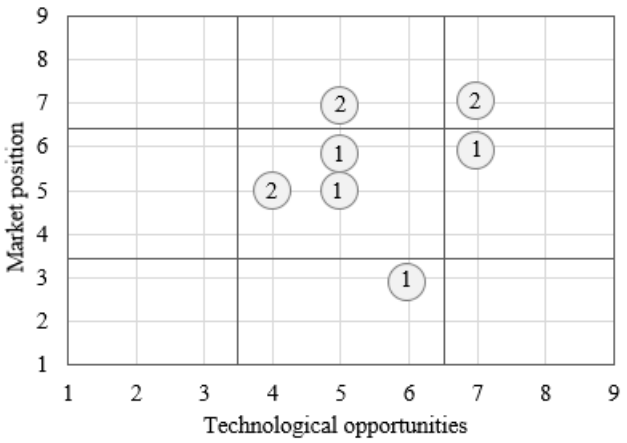

Fig. 4. Map of the number of KPI assessments against a 3x3 matrix

In the individual areas of the 3x3 matrix, the number of assessments was summed up It can be seen that the distribution of assessments is not even. The pairs of assessments are mainly concentrated in the central part of the matrix. The areas for improvement are also clearly depicted.

In the context of technological capabilities, it can be seen that KPIs relating to OEE, lead time and flexibility have obtained the highest values - the closest to achieving the company's goal. Therefore, a practical recommendation is to intensify the foundry's activities in order to make greater use of technological capabilities and to intensify inter-organisational cooperation activities, Motivation for increased activity in this area can be: better use of environmental opportunities, access to resources not previously available, increase in flexibility of activities (Albani and Dietz, 2009; Deqiang et al., 2021). Key benefits, on the other hand, can include: access to in-formation, product development or the possibility of conquering new markets (Hys and Hawrysz, 2012). The implementation of the indicated activities will enable the shift of performance upwards in the 3x3 matrix.

The map of the number of assessments reveals a few points away from the position of the other indications - located in the "discover the incidental" area. Activities in relation to the KPIs included in this case should relate to the increase in the level of human resources in the area, as they are of strategic importance for the functioning of enterprises, especially their development. Development activities should focus on: acquiring and supplementing professional knowledge (specialised issues), acquiring and developing practical skills and shaping appropriate professional attitudes (Ligarski et al., 2021). The implementation of the proposed investments in the development of human resources will also have a positive impact on the human resources profitability index, which will be another benefit for the company.

The proposed improvement measures will have a positive impact on the indicators whose values deviate most from the target area: "focus on the revealed chance".

5. Summary and conclusion

Casting is defined as an industrial method of manufacturing products by filling moulds with molten metal. The solidification process makes it possible to maintain the shape of the product in its liquid state. This pro-cess is considered to be a complex and multi-stage process, characterised by a significant number of technological parameters determining the quality of the finished products and, consequently, customer satisfaction and opinion. Which in turn affects market positioning and competitiveness. For this reason, it is crucial to develop an effective strategy that clarifies the further development of the company. The aim of the study was to develop a model to define the current position of the manufacturing company in the market using KPIs in relation to the key product - gearbox casting. The company's position was defined in terms of the relationship between technological capabilities and market position.

The implementation of the research made it possible to define the position of the company (in terms of technological capabilities and market position) as a "Search for occasions" - box 9 within the 3x3 matrix. Which means that the company can be defined as average. The areas examined were assessed using key performance indicators selected according to the needs and capabilities of the company. Significant determinants of technological performance weakening the pre-enterprise position were low indications of maintenance capability and unjustifiably long production cycle times. On the other hand, a factor with a strong negative impact on the market position was found to be: the low level of human resources development in the area studied. The company's management should undertake improvement projects in relation to sensitive areas. Which will be aimed at achieving a permanent and satisfactory position in the automotive foundry industry.

The indicator analysis for the identification of the technological position on the market, proposed in the study, can be a useful procedure for determining the position of both manufacturing and service companies in various industries. The indicated action is intended to facilitate the development of an appropriate development strategy. Future research directions will include the remaining key aluminium alloy casting products of the company and the development of additional and relevant KPIs in relation to the identified company hotspots.

Reference

Aksu, U., Schunselaar, DMM., Reijers, HA., 2019. Automated prediction of relevant key performance indicators for organizations. BUSINESS INFORMATION SYSTEMS, PT I, Lecture Notes in Business Information Processing, 353, 283-299. DOI: 10.1007/978-3-030-20485-3_22.

Barbieri, N., Barbieri, GDV., Martins, BM., Barbieri, LDV., de Lima, KF., 2019. Analysis of automotive gearbox faults using vibration signal. Mechanical Systems And Signal Processing, 129, 148-163. DOI: 10.1016/j.ymssp.2019.04.028.

Borkowski, S., Ulewicz, R., Selejdak J., Konstanciak, M., Klimecka-Tatar, D., 2012. The use of 3x3 matrix to evaluation of ribbed wire manufacturing technology. in Proc. 21st Internatonal Conference on Metallurgy and Materials METAL 2012, 1722-1728.

Borkowski, S., Ingaldi, M., Jagusiak-Kocik, M., 2014. The use of 3x3 matrix to evaluate a manufacturing technology of chosen metal company. Management Systems in Production Engineering, 3(15), 121-125.

Daryani, SM., Khodaverdi, Y., Rasouli, E., Ehareghi, B., 2012. The importance of knowledge management technologies in performance improvement of organizations. Life Science Journal-Acta Zhengzhou University Overseas Edition, 9(9), 4695-4699.

Deqiang, S., Zhijun, C., Hajduk-Stelmachowicz, M., Larik, AR.,Rafique, MZ. 2021., The role of the global value chain in improving trade and the sustainable competitive advantage: evidence from china's manufacturing industry. Frontiers in Environmental Science, 9, 779295. DOI: 10.3389/fenvs.2021.779295.

Di Luozzo, S., Keegan, R., Liolli, R., Schiraldi, MM., 2022. Key activity indicators: critical review and proposal of implementation criteria, International Journal Of Productivity And Performance Management, DOI: 10.1108/IJPPM-01-2022-0023.

Gawlik, R., 2016. Methodological aspects of qualitative-quantitative analysis of decision-making processes. Management And Production Engineering Review, 7(2) ,3-11. DOI: 10.1515/mper-2016-0011.

Hren, JA., Michna, S., Michnova, L., 2019. Dependence of mechanical properties on porosity of alsi7mg0.3 alloy during gravity casting. 18th International Scientific Conference Engineering For Rural Development, Engineering for Rural Development, 1001-1006. DOI: 10.22616/ERDev2019.18.N076.

Hristov, I., Chirico, A., The role of sustainability key performance indicators (KPIs) in implementing sustainable strategies, Sustainability, 11(20), DOI: 10.3390/su11205742

Hys, K., 2015. Zjawisko koncentracji i delokalizacji w branży motoryzacyjnej. Handel Wewnętrzny, Instytut Badań Rynku, Konsumpcji i Koniunktur, 5(358), 163-175.

Hys, K., Hawrysz, L., 2012. Corporate social responsibility reporting. China-USA Business Review, David Publishing Company, Inc., 11(11). DOI:10.17265/1537-1514/2012.11.009.

Ingaldi, M., 2014. Use of the SWOT ANALYSIS and 3x3 matrix to determine the technological posistion of the chosen metal company. Acta Metall. Slovaca – Conf. 4, pp. 207–214. DOI: 10.12776/amsc.v4i0.248.
Joppen, R., von Enzberg, S., Gundlach, J., Kuhn, A., 2019. Key performance indicators in the production of the future. 52nd Cirp Conference On Manufacturing Systems (Cms), Procedia CIRP, 81, 759-764. DOI: 10.1016/j.procir.2019.03.190.
Kim, J., Oh, I., 2022. Adoption of emerging technologies and growth of manufacturing firms: the importance of technology types and corporate entrepreneurship. Technology Analysis & Strategic Management, DOI: 10.1080/09537325.2022.2149393
Klimecka-Tatar, D., Ingaldi, M., 2020. Assessment of the Technological Position of a Selected Enterprise in the Metallurgical Industry. Materials Research Proceedings, 17, 72-78. DOI: 10.21741/9781644901038-11.
Korzyński, M., Pacana A., 2010. Centreless burnishing and influence of its parameters on machining effects. Journal of Materials Processing Technology, 210, I:9, 1217-1223. DOI: 10.1016/j.jmatprotec.2010.03.008.
Ligarski, MJ., Rozalowski, B., Kalinowski, K., 2021. A study of the human factor in industry 4.0 based on the automotive industry. Energies, 14(20), 6833. DOI: 10.3390/en14206833.
Lyp-Wrońska, K., Wolniak, R., Sulkowski, M., 2018. determinant of quality in metalworking enterprises. 27th International Conference On Metallurgy And Materials (Metal 2018), 2029-2035.
Makarova, I., Mukhametdinov, E., Gabsalikhova, L., Shepelev, V., Galiev, S., Buyvol, P., Drakaki, M., 2021. Ensuring reliability of the gearbox during operation stage. Proceedings Of The 7th International Conference On Vehicle Technology And Intelligent Transport Systems (Vehits), 768-774. DOI: 10.5220/0010530707680774.
Maszke, A., Dwornicka, R., Ulewicz, R., 2018. Problems in the implementation of the lean concept at a steel works - Case study. MATEC Web of Conferences, 183.
Manzano-Ibarra, M., Zamora-Sanchez, R., Medina-Chicaiza, P. 2019. Methodological proposal for generation of key performance indicators supported on information technology. 3C Tecnologia, 8(1), 10-28. DOI: 10.17993/3ctecno/2019.v8n1e29/10-29.
Miskinis, GV. 2021. Transformation of the modern foundry. International Journal Of Metalcasting, 15(4), 1118-1128. DOI: 10.1007/s40962-021-00645-0.
Murad, Ma., Thomson, JD., 2011. The importance of technology diffusion in Malaysian Manufacturing SMEs, Information And Financial Engineering. ICIFE 2011, International Proceedings of Economics Development and Research, 12, 81-85.
Pacana, A., Czerwińska, K., Bednarova, L., 2019. Comprehensive improvement of the surface quality of the diesel engine piston. Metalurgija, 58 (3-4), 329-332.
Pacana, A., Czerwińska, K., 2020. Improving the quality level in the automotive industry. Production Engineering Archives, 26(4), 162-164. DOI: 10.30657/pea.2020.26.29.
Pietraszek, J., Radek, N., Goroshko, AV., 2020. Challenges for the DOE methodology related to the introduction of Industry 4.0. Production Engineering Archives, 26(4), 190-194. DOI: 10.30657/pea.2020.26.33.
Pietraszek, J., Skrzypczak-Pietraszek, E., 2014. The optimization of the technological process with the fuzzy regression. Terotechnology, Advanced Materials Research, 874, 151+. DOI: 10.4028/www.scientific.net/AMR.874.151.
PN-EN 1706:2011, Aluminum and aluminum alloys Castings. Chemical composition and mechanical properties, 2011, Warszawa: PKN.
PN-EN 15341:2007, Maintenance – Maintenance Key Performance Indicators. 2007, Warszawa, PKN.
Siegfanz, S., Gietler, A., Michels, W., Krupp, U., 2013. Influence of the microstructure on the fatigue damage behaviour of the aluminium cast alloy AlSi7Mg0.3, Materials Science and Engineering A-Structural Materials Properties Microstructure And Processing, 565, 21-26. DOI: 10.1016/j.msea.2012.12.047.
Ulewicz, R., Czerwińska, K., Pacana, A., 2022. A Rank Model of Casting Non-Conformity Detection Methods in the Context of Industry 4.0. Materials 2023, 16, 723, DOI: 10.3390/ma16020723.
Ulewicz, R., Mazur, M., 2019. Economic aspects of robotization of production processes by example of a car semi-trailers manufacturer. Manufacturing Technology, 19(6), 1054–1059
Werner, MJE., Yamada, APL., Domingos, EGN., Leite, LR, Pereira, CR., 2021. Exploring organizational resilience through key performance indicators. Journal Of Industrial And Production Engineering, 38(1), 51-65, DOI: 10.1080/21681015.2020.1839582
Wolniak, R., Szeptuch, A., Ziecina, G. 2017. Analysis of behavior of management in an international metallurgical company. using Cameron and Quinn typology, E-mentor, 2, 60-69.
Zimmermann, G., Sturz, L., 2007. Microstructure formation in AlSi7Mg alloys directionally solidified in a rotating magnetic field, Steel Research International, 78(5), 379-385. DOI: 10.1002/srin.200705907.

制造业公司的技术地位的指标分析

關鍵詞
关键绩效指标
金属工业
质量管理
机械工程
指数分析

摘要
动荡的制造业市场，尤其是金属行业，决定了产品质量和生产效率水平，这有助于公司的市场地位和竞争能力。该研究的目的是开发一个模型，利用关键绩效指标来定义一个制造公司目前的市场地位，与一个关键产品--齿轮箱铸件有关。该公司的地位是根据技术能力和市场地位之间的关系来定义的。该研究的另一个目的是确定关键的决定因素，并最终确定加强市场地位的条件。作为对拟议模型的测试，被分析公司的地位（在技术能力和市场地位方面）被定义为 "寻找机会"--3x3矩阵中的方框9。削弱公司地位的技术决定因素（维护能力水平低和生产周期长）和对市场地位有强烈负面影响的决定因素（人力资源开发水平低）被确定下来。一个新的因素是使用关键绩效指标作为决定公司在3x3矩阵中的位置的变量，这表明了公司在市场中的具体技术地位。进一步的再研究将涉及确定与公司已确定的关键领域有关的适当的关键绩效指标。随后的步骤将涉及该模型对该公司其他关键铝合金铸件的影响。